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This guide was prepared as an aid to teachers of general science 1-2, grade 8. One of the major purposes of the guide is to assist the teachers in adopting a discovery-oriented approach in the classroom. The course is designed to prepare able students for the advanced science courses, grades 9-12. Teaching techniques, homework, laboratory experiences, safety, evaluation, and individual research projects are discussed. Eleven study units are presented including perception, life, biochemistry, sound, astronomy, light, chemistry, nuclear energy, and geology. Appendices include suggested student problems and various charts and tables. (BC)

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A GUIDE FOR TEACHING
GENERAL SCIENCE 1-2 (8th)

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San Diego City Schools
San Diego, California
1967

A GUIDE FOR TEACHING GENERAL SCIENCE 1-2 (8th)

Prepared by

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At the Request of

The Curriculum Council

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San Diego City Schools
San Diego, California
1967
Unedited

PREFACE

This publication was prepared as an aid to teachers of General Science 1-2 (8th) when it became evident that the adoption of new state textbooks, The Molecule and the Biosphere and The Atom and the Earth, would necessitate a new teaching guide. This Guide for General Science 1-2 (8th) was prepared at the suggestion of, and with the assistance of, the Junior High School Science Study Committee.

General Science 1-2 (8th) has been primarily a lecture-demonstration course. However, it is hoped that the use of this publication, together with the new textbooks and their associated materials, will lead to a more discovery-oriented approach and will provide both students and teachers with a more stimulating and meaningful science experience.

Readers will understand that this guide was written before the state printing of the basic texts was available. Every effort was made to coordinate page numbers with the state printing, but the teacher should be alert to possible variations.

Readers will also understand that this guide was prepared for publication during a busy summer curriculum workshop and, because of the pressure of time, has not been carefully edited. Evaluations, suggestions for improvement, and any additional experiments, demonstrations, or work sheets should be sent to the Science Specialist, Curriculum Services Division, before the end of the school year. Forms for evaluation are provided at the end of each unit of the guide.

Wm. H. Stegeman
William H. Stegeman
Assistant Superintendent
Curriculum Services Division

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INTRODUCTION

This first formal course in science, General Science 1-2 (8th), is designed to prepare the most interested and able science students in Grade 8 for the district's advanced science program in Grades 9-12. The student who successfully completes this course will have the necessary preparation for an introductory semester of biology and an introductory semester of chemistry at Grade 9, and will progress to advanced biology at Grade 10, and/or advanced chemistry at Grade 11, and "Honors Physics" at Grade 12 if he so desires.

Students should be selected for this course on the basis of being more highly motivated, having higher verbal and quantitative ability, and being more capable of abstract thinking than the typical eighth grade student. Therefore, a faster pace may be set and a wide variety of enrichment materials may be utilized.

The problem of selecting materials to be covered from the two available basic textbooks has been resolved in two ways: (1) on the basis of selected conceptual themes (see "Point of View" and "Objectives"), and (2) whether or not certain concepts are likely to be covered adequately in General Science 3-4 at Grade 9. The emphasis is changing, as a result of the new text adoption by the state, from a more fact- and specific-discipline-oriented approach to a more concept- and interdisciplinary-oriented approach, reflecting the national trend in science teaching.

Many teachers in this school district have already been emphasizing a basic concept-scientific method approach to science teaching; however, these new texts should make it easier for all students to appreciate the broad fundamental base on which science is built. The use of this guide will enable each teacher to develop an effective utilization of the wide variety of resource materials now available.

Course Description *

GENERAL SCIENCE 1-2 (8th) (two-semester course--Grade 8--prerequisites: interest, high academic ability, above average reading ability, selection by teacher and/or advisor)

Description of course:

This course is offered to the most interested and able science students in the eighth grade. It includes most of the content of ninth-grade General Science 1-2 and, in addition, material on the earth sciences and astronomy which are normally covered in the regular eighth-grade semester course.

Instructional content or areas of emphasis:

Perception and interaction in science*	3 weeks
Life in a physical world*	4-5 weeks
Biochemistry*	3 weeks
Biophysics of sound	2 weeks
Astronomy and life in space*	5 weeks
Energy of light	2 weeks
Introductory chemistry concepts	3-4 weeks
Nuclear energy of the atom	2 weeks
Electronics	2 weeks
Geoscience - geology, oceanography, meteorology	7-8 weeks
From atmosphere to space	2 weeks

*Instruction in the important topics of alcohol, tobacco, narcotics and other dangerous substances will be included as integral parts of these units.

Basic texts: Navarra, et. al., The Molecule and the Biosphere, 1965
Navarra, et. al., The Atom and the Earth, 1965

Supplementary texts: Ramsey, et. al., Modern Earth Science, 1965
Univ. of Illinois, Astronomy Series, 1966
Charting the Universe, 1
The Universe in Motion, 2
Gravitation, 3
The Message of Starlight, 4
The Life Story of a Star, 5
Galaxies and the Universe, 6
(See current Approved List of Basic and Supplementary Textbooks for Junior and Senior High Schools, 1967-1968.)

Guides: Guide for General Science 1-2 (8th), 1967
Handbook of Science Laboratory Practices and Safety, 1966

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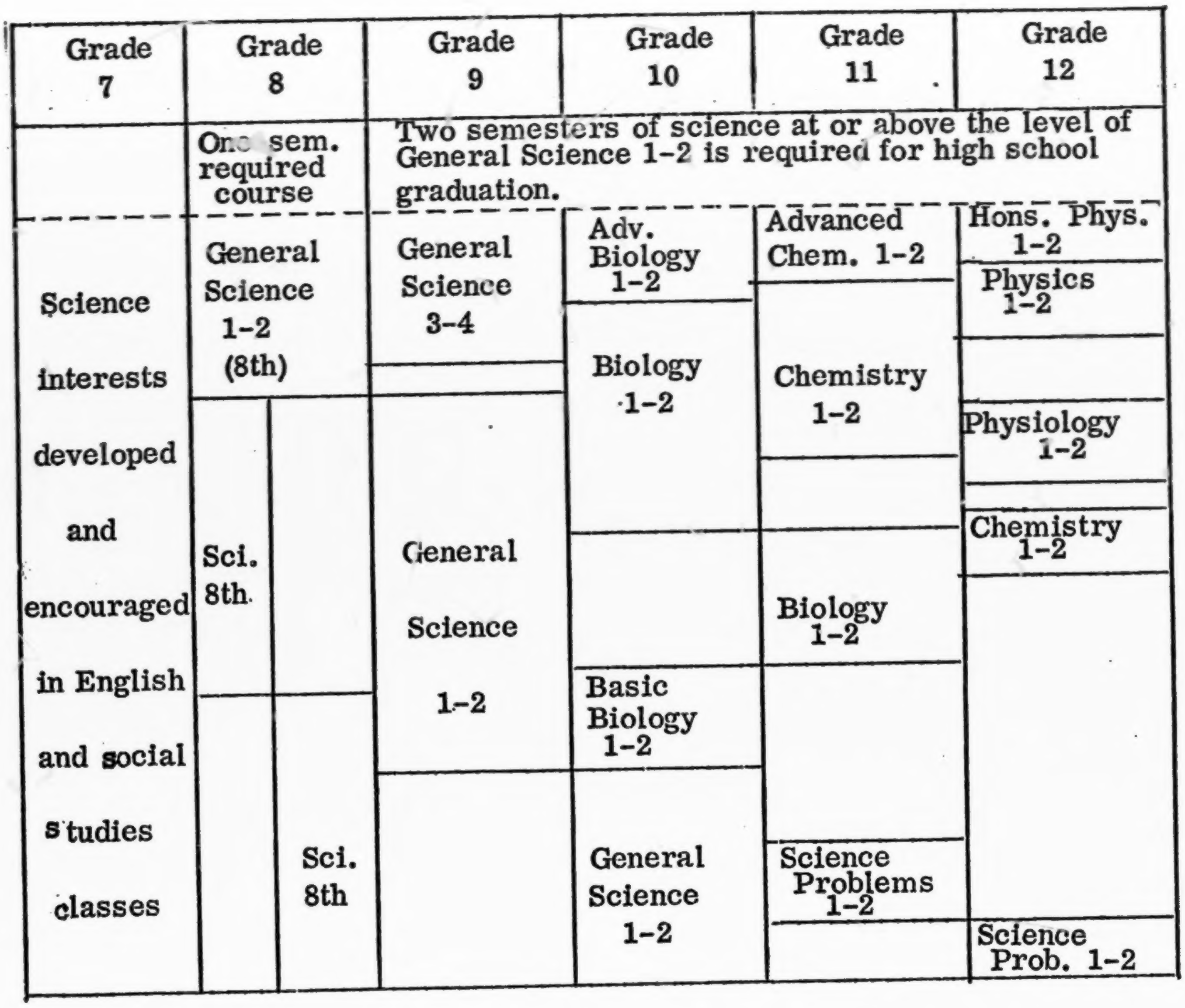
* San Diego City Schools, Digest of the Secondary School Cirriculum, published annually, San Diego, California.

Course Sequence*

DIAGRAM OF COURSE SEQUENCE



Note: The above chart indicates the distribution of students at each grade level among the courses offered. The distribution shown is district-wide and not that of any one school. In senior high schools, especially, inclusion of summer school enrollments would increase the proportion of students taking science courses.

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*San Diego City Schools, Digest of the Secondary School Curriculum, published annually, San Diego, California.

Point of View

The body of knowledge referred to as "science" has become a highly complex, interwoven network of ideas. In order to ensure the transmission of the information and spirit of science from generation to generation, certain basic ground rules may be established. As science teachers, we believe:

-That "science" exists only in man's mind and is therefore constantly changing as man's experiences, observations, and the interpretations of his experiences and observation change.

-That science consists not only of interrelated bits of knowledge but also of an approach to solving problems in a logical manner.

-That many concepts in science may be best understood and retained if presented in such a way that the student discovers them for himself.

-That the scientific approach to solving problems in a logical manner can only be fully appreciated by the student if he is given many opportunities to apply this method in the laboratory.

-That the scientific approach also involves certain attitudes and assumptions that are indispensable to the progress of science.

-That the body of knowledge called science is so complex and is expanding so rapidly that no one would expect to learn all the information that scientists accept as facts.

-That an understanding of certain "basic concepts" or "conceptual themes" will enable a student to build a mental framework of the structure of science within which he may interpret his experiences in science throughout his life.

Objectives

Science teaching at the junior high level should attempt to help each student make as much progress toward the following general objectives as he can with a maximum benefit and satisfaction to himself. The student who successfully completes General Science 1-2 at Grade 8 should have made progress toward becoming:

-Familiar with the major concepts of science that form the basis of all study in the life, physical, and earth sciences.

-Able to apply many of the skills of observing, obtaining data, and reasoning required to pursue inquiry in the life, physical, and earth sciences.

-Aware of the role that the life, physical, and earth sciences and individuals working in these areas have in economic and social progress of society.

-Able to read more effectively and critically articles and news items of scientific interest in the areas of the life, physical, and earth sciences.

The basic conceptual themes for content (big ideas) referred to above, and in the Introduction and the Point of View sections of this guide, provide a framework around which the body of knowledge called science may be organized. These themes have been stated by the Advisory Committee for a Science Framework, set up by the California State Department of Education, as follows:

A. Events in nature occur in a predictable way, understandable in terms of a cause-and-effect relationship; natural laws are universal and demonstrable throughout time and space.

B. Frames of reference for size, position, time, and motion in space are relative, not absolute.

C. Matter is composed of particles which are in constant motion.

D. Energy exists in a variety of convertible forms.

E. Matter and energy are manifestations of a single entity; their sum in a closed system is contant.

F. Dissimilarity and diversity are normal qualities in natural phenomena.

  1. Matter is organized into units which can be classified into organizational levels.

  2. Living things are highly organized systems of matter and energy.

  3. Structure and function are interdependent.

G. Units of matter interact.

   1. The bases of all interactions are electromagnetic, gravitational, and nuclear forces whose fields extend beyond the vicinity of their origin.

   2. Interdependence and interaction with the enviornment are universal relationships.

   3. Interaction and reorganization of units of matter are always associated with changes in energy.

A simple statement of the "processes" or "methods" of science is more difficult to organize. Scientists and science educators generally agree that there is no single set "method" of science. The following general outline suggests some behaviors a scientist might exhibit in pursuing scientific inquiry.

A. Identifying (perceiving) the problem

   1. Forming hypotheses
   2. Building working definitions

B. Experimenting on the problem

   1. Recognizing space-time, number, and other relationships
   2. Observing
   3. Classifying
   4. Measuring
   5. Controlling and manipulating variables

C. Evaluating the results

   1. Interacting with others
   2. Inferring
   3. Predicting
   4. Organizing ideas into models
   5. Interpreting data

The teacher should realize that the above behaviors do not necessarily occur in any set pattern and that ideas may be discarded and certain steps repeated several times in the course of any single investigation. However, the traditional five or seven steps in the scientific method are still used in reporting investigations to others.

Overview

The following chart suggests a unit sequence and time allotment. Student interest and the teacher's background will lengthen some of the units at the cost of others. Keep in mind, as these changes occur, the need for good over-all balance and the fact that many of these units will depend upon understanding preceding units.

The suggested solution to the problem of using the two basic textbooks in a one-year course is to teach from first one and then the other as indicated below, with only one unit utilizing the two texts. In general, the textbooks are organized in such a way that approximately one chapter may be covered in one week.

BASIC TEXT CHAPTERS* Book 7 and Book 8		COURSE UNIT	TIME
1		PERCEPTION AND INTERACTION IN SCIENCE	3 weeks
2,3,4,5,		LIFE IN A PHYSICAL WORLD	4-5 weeks
9,10,11		BIOCHEMISTRY	3 weeks
12,13,14		BIOPHYSICS OF SOUND	2 weeks
17,18	1	ASTRONOMY AND LIFE IN SPACE	5 weeks
	2	ENERGY OF LIGHT	2 weeks
	4,5,6	INTRODUCTORY CHEMISTRY CONCEPTS	3-4 weeks
	7,8	NUCLEAR ENERGY OF THE ATOM	2 weeks
	9 (10 optional)	ELECTRONICS	2 weeks
	11,12,13, 14,15	GEOSCIENCE--GEOLOGY, OCEANOGRAPHY, METEOROLOGY	7-8 weeks
	16,17,18	FROM ATMOSPHERE TO SPACE	2 weeks
		Total (minimum)	35 weeks

*Book 7 - Navarra, et. al., The Molecule and the Biosphere, 1965.
*Book 8 - Navarra, et. al., The Atom and the Earth, 1965.

GENERAL SUGGESTIONS FOR TEACHERS

Content and Use of the Guide

The publishers of the basic textbook have provided a teacher's edition which will assist the teacher in planning the day-to-day discussion activities. This Guide for Teaching General Science 1-2 (8th) is intended to complement the commercial publication by assisting the instructor in making the full use of the wide variety of resources and materials available in San Diego. It is anticipated that the teacher will have major subject matter training in either life sciences, chemistry, or physics and will probably not be an expert in all of the areas included in a general science course. This guide will therefore provide information and material as follows:

-GOALS OF THE UNIT provides a concise statement of the unit content.

-TEACHING SUGGESTIONS lists basic text chapters and teaching tips pertinent to each unit.

-BOOKS REFERRED TO IN THIS UNIT provides a complete bibliographic reference to basic and supplementary books; titles and page references only are listed in the main body of the unit.

-CONCEPTS TO BE DEVELOPED are listed as suggested by the authors of the basic texts.

-RESOURCES include:

Text and supplementary text references related to the specific topic.

Resource materials of a special nature including teacher handbooks, free and inexpensive materials, etc.

Audio-visual materials that are available from San Diego City Schools Instructional Aids Distribution Center.

Materials normally available from the science department or custodian.

-ACTIVITIES including materials and ideas are as follows:

Suggested laboratory exercises
Suggested discussion topics
Suggested activities

-SUGGESTED TOPICS FOR STUDENT INVESTIGATIONS AND RESEARCH PROJECTS.

-EVALUATION SHEET for feedback of suggestions by teachers.

The Appendix contains maps, charts, work sheets, and laboratory exercises. These sheets may be used as masters for the production of transparencies and/or spirit-duplicator masters. The teacher will find it practical to reproduce most of these sheets for distribution on a one-per-student basis.

Teaching Techniques

Instruction in this course as in all science courses should emphasize the active participation of students in discussions, investigations, experimentations, and in planning demonstrations. Many resources such as books, laboratory materials, films, filmstrips, work sheets, laboratory exercises, reports, projects, and guest speakers should be used to provide a variety of experiences designed to stimulate the interests and imagination of student and teacher alike.

Homework

A regular and reasonable amount of out-of-class work is necessary in order to provide adequate coverage of topics and to maintain the students' activity and interest. Textbook reading, notebook work, special reports, setting up demonstrations or experiments, and so forth can generally be considered out-of-class work. This procedure is recommended and should be expected of advanced eighth grade students.

Student Notebook

Each student should keep a notebook as a means of organizing and recording information learned in the course. The notebook may contain such things as: discussion notes, work sheets, write-ups of experiments and demonstrations, notes on films, and other pertinent information.

Such required activities on the part of students should be checked or graded periodically. Neatness (but not artistic ability), originality, promptness, completeness, accuracy, effort, understanding, and problem-solving approach should be considered in grading the notebook.

Keeping the notebook should facilitate learning and should not involve so much time as to limit the materials covered or methods used. The notebook is only one part of the total learning situation that involves many methods and materials.

Student Laboratory Experiences

The guide provides numerous suggestions for classroom activities. It is obviously not possible to use all of them and the teacher must choose those which he deems most appropriate. Some suggestions may be modified to provide additional small-group laboratory exercises.

Laboratory instructions are provided for a number of exercises that may be done by the students. For most of the exercises, two or three students per team would probably be appropriate, although this may vary for a particular exercise. As the number of students per team increases above three, the value to the individual student in being able to observe and develop techniques decreases significantly.

General Science 1-2 (8th) students will have had little previous opportunity for actual laboratory experiences and will need careful preparation and supervision, expecially during the early part of the year. They should be expected to follow directions carefully and to proceed in a businesslike manner. They should be instructed not to attempt any experimentation that is not specified in the instructions or specifically approved by the instructor.

Much of the value of any laboratory experience is derived from the preliminary and follow-up discussions of the exercise. Some of the students will miss the point of the experiment entirely unless guidance is given, and new questions will often arise that need exploration.

The teacher information which accompanies each exercise was designed to facilitate preparation. It also draws attention to some aspects of the exercise that may be of particular concern, as well as some supplementary information to the teacher who may be teaching a unit out of his field.

Safety

It is extremely important to stress safety in the performance of laboratory demonstrations and experiments. Teachers should familiarize themselves with the San Diego City Schools publication, Handbook of Science Laboratory Practices and Safety (Stock No. 41-L-0500), before engaging in any laboratory activity. Information of particular importance for junior high school science teachers may be found on pages 1-3, 7, 15-29, 33-40, 47-48; refer to other sections as needed. Careful consideration should be given in planning each laboratory experience to determine the optimum amount and kind of student training in laboratory procedure that should be given.

Student Evaluation

The authors of the basic text have prepared chapter tests to assist in student evaluation. Copies of these tests are provided each school to serve the teacher as guidelines in preparing his evaluative devices. The teacher should bear in mind the value of carefully prepared tests and quizzes as teaching devices. Student evaluation should naturally include all phases of classwork and homework, as well. Additional guidelines for pupil self-evaluation and teacher evaluation of pupil progress have been provided by the authors on page xii of the teacher's editions of both texts.

Student Grading Practices

The faster pace, the in-depth coverage of material, and the preselected students involved in this course necessitate a few guidelines concerning grading practices in order to assure uniformity from school to school. The teacher should keep in mind that:

- These students have already been selected in such a way that they should all be capable of doing average or better work.

- The variety of maturity levels exhibited by students at this grade level may make the predictions of a student's future performance difficult.

- In most cases only those students doing above average work (B or better) will be counseled into continuing an advanced science program.

Individual Research Projects

Individual research projects and classroom exhibits should be encouraged. Many science-minded students obtain satisfaction in attempting to solve problems even if results are often inconclusive. Frequently they lead on to further experimentation. Each project undertaken by a student will undoubtedly lead to more knowledge and appreciation of the work in some phase of science. Projects are beginnings, not ends in themselves. With certain students, it may be advisable to accept a research project in lieu of certain class reqirements such as notebooks, book reports, or other assignments. Some teachers have found that many superior students rebel at routine assignments and requirements. Additional guidelines will be found on page 11 of the San Diego City Schools publication Handbook of Laboratory Practices and Safety (Stock No. 41-L-0500).

SUPPLIES AND EQUIPMENT

District Procedure No. 7275 provides a method of setting up a direct purchase account. The teacher should familiarize himself with this procedure, plan his needs, and discuss with his principal the possibility of setting up such an account. A number of items, especially perishable food items, suggested in the activities for this course may be obtained most easily in this manner.

Several items of supplementary science equipment are available from the Instructional Aids Distribution Center for distribution to schools on request for use by science teachers on a one-week loan basis. Requests may be placed by calling Mr. Mahoney, at 298-4681, Ext. 307.

	Number Teachers May Request	
Audio Oscillator	1	(teacher pick up and return only)
Elementary Microscope, 100X with Rite-Lite	up to 9	
Light and Color Mixing Apparatus	1	
Microscopes: Dissecting	up to 2	
Polarizing	up to 2	
Microscope - Olympus Elgeet	1	
Microscope - Oil Immersion Lens	1	
Microscope - Monocular	1 set of 12	
Microscopes - Binocular	up to 5	
Oscilloscope	1	(teacher pick up and return only)
Planetarium Model	1	
Questar	1	
Radiation Detector Kit	1	
Strobe (Demonstration)	1	

UNIT I

PERCEPTION AND INTERACTION IN SCIENCE

UNIT I

PERCEPTION AND INTERACTION IN SCIENCE
(3 Weeks)

Goals of the Unit

During his study of this unit the student discovers and begins to appreciate some broad, fundamental principles behind the ways scientists work. In particular he learns: (1) how each person perceives, (2) how science is a way of perceiving, and (3) the importance of interaction between scientists. As these concepts are presented the student also gains an insight into the structure and operation of the human nervous system and the effects of various substances on it.

Teaching Suggestions

This unit follows the basic textbook, The Molecule and the Biosphere, Chapter 1, and then adds related material to provide additional emphasis in certain areas. The experienced teacher will have a variety of other ideas that may be used in conjunction with, or in place of, the audio-visual aids, supplementary materials, and suggested student activities coordinated here.

It is recommended that the student be led to realize that there is no single set "method" of pursuing scientific investigations; rather, many books refer to a standard form of the "scientific method" that is used in reporting investigations after they have been completed.

It is further recommended that students be encouraged to pursue investigations and to practice techniques of problem-solving. Some suggested problems are presented to illustrate the type of problems to use in this practice.

Books Referred to in This Unit

Navarra, John G., et. al. Today's Basic Science: The Atom and the Earth.
New York: Harper and Row, 1965

Navarra, John G., et. al. Today's Basic Science: The Molecule and the Biosphere.
New York: Harper and Row, 1965.

Ploutz, Paul F., et. al. Laboratory Manual: Basic Physical Science. Syracuse,
New York: L. W. Singer Company, 1964.

Concepts to be Developed

1. Perception is the act of perceiving or of becoming aware of something through the senses.

2. Some form of energy must be available if we are to perceive; energy makes it possible for us to see, hear, feel, smell, and taste.

3. A stimulus is energy that activates a part of the body.

4. To perceive, a person first must make a contact with an object, a situation, or event; a stimulus provides this contact.

5. A stimulus can come from outside the body or from within the body.

6. Sense cells and sense organs detect the energy which enables us to perceive.

7. The five basic senses are the senses of sight, hearing, smell, taste, and touch; in all, the human body responds to more than twenty sensations.

8. The eye is an important sense organ; it gives us the sense of sight.

9. A combination of stimuli sharpens our perceptions; eyes and ears, for example, often work together.

10. The nervous system serves as a communications network for the human body.

11. The brain and the spinal cord make up the central nervous system; neurons, or nerve cells, form a subdivision known as the peripheral nervous system.

12. The autonomic nervous system controls involuntary action of various body organs (the heart, stomach, and colon, for example).

13. The brain consists of three main parts: the cerebrum, the cerebellum, and the medulla.

14. Many impulses pass through the spinal cord on their way to the brain.

*15. Alcohol and narcotics have many and varied effects on the nervous system.

16. Science is a way of perceiving.

17. Scientists solve problems and make discoveries by making contact, detecting energy, transmitting energy, and receiving energy.

*18. Science also involves interaction--a give-and-take experience between two persons or between a person and the conditions of his environment.

*19. The individual investigation, perhaps in the form of a science project, is a valuable experience in understanding the ways in which scientists work.

*20. Studies of science and mathematics are closely related. Mathematics is an important tool of the scientist.

*21. The metric system of measurement is used internationally by scientists.

*22. Familiarity with available materials and the application of good study habits will increase the student's success in his science studies.

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*Concepts not quoted from the basic text teacher's guide.

Resources and Activities

CONCEPTS	RESOURCES
1. Perception is the act of perceiving, or of becoming aware of something through the senses. 2. Some form of energy must be available if we are to perceive; energy makes it possible for us to see, hear, feel, smell, and taste.	1, 2 The Molecule and the Biosphere, pp. 9-11
3. A stimulus is energy that activates a part of the body. 4. To perceive, a person first must make a contact with an object, a situation, or event; a stimulus provides this contact. 5. A stimulus can come from outside the body or from within the body.	3, 4, 5 The Molecule and the Biosphere, pp. 12-15

ACTIVITIES

1, 2

a. Use activities suggested in the teacher's edition, *Book 7, pp. 2-22, to develop these and subsequent concepts.

b. Use Investigation 1 in text, p. 10.

c. Use "black box" type investigation, perhaps as suggested in ESCP text Investigating The Earth, 1965 Edition, Investigation P-1.

d. Use "tricky spool" investigation. To make the tricky spool, paste a gummed label over each end of a wooden spool and prick one hole in each end with a pin. Hold to the light. What do you observe? In one end, prick two more holes close to the one already there. Hold to the light. What do you see? Some will see three holes in each end. Others will see other combinations. Let the class try to find the explanation for the varied observations.

e. Recall the poem "The Blind Man and the Elephant," by John G. Saxe. Were the blind men scientists? Justify the conclusions.

f. Without any preliminary statement as to your purpose, display large cardboard on which are arranged about 40 one-inch circles that are colored red, yellow, blue, and green. Vary the number of each color. Show the circles for half a minute, then cover completely. Ask the class how many blue circles there were. Record on the board the numbers given by the class. Repeat the procedure, but this time give a preliminary direction indicating you will ask for the number of red circles on the chart. Elicit from students the reasons for the more accurate counts in the second trial.

g. Light a candle and ask the students what is burning. When they say it is the candle, place the head of a match near the side of the candle and show that it does not burn. When they say it is the wick that is burning, light a string and show that it is quickly consumed--not as in the burning they see in the burning candle. Next, light the candle and snuff it out so that students can see the rising smoky vapor. Then quickly bring a lighted splint close to the vapor around the wick. Explore with the class the ways that keener observation helped in explaining what happened in the demonstration.

3, 4, 5

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Let the class observe the reactions of snails or other invertebrates to various external stimuli. Observe the feeding response of hydra, or various responses of paramecia.

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* "Teacher's edition", as used throughout this guide, refers to the buff-colored pages of teacher information bound into the front of the student text labeled "Teacher's Edition."

CONCEPTS	RESOURCES
6. Sense cells and sense organs detect the energy which enables us to perceive. 7. The five basic senses are the senses of sight, hearing, smell, taste, and touch; in all, the human body responds to more than twenty sensations. 8. The eye is an important sense organ; it gives us the sense of sight. 9. A combination of stimuli sharpens our perception; eyes and ears, for example, often work together.	6, 7, 8, 9 The Molecule and the Biosphere, pp. 15-19 FILMS Eyes and Vision, Col., 10 min. Eyes: Their Structure and Care, Col., 11 min. Gateways to the Mind, Part I, Col., 30 min. Gateways to the Mind, Part II, Col., 30 min. Sense Perception, Part I: The Wonder of the Senses, Col., 27 min. Sense Perception, Part II: The Limitation of the Senses, Col., 28 min. FILMSTRIPS Fs 612.8 Human Sense Organs Fs 612.8 You and Your Five Senses

6, 7, 8, 9

a. Use activities suggested in the text and teacher's edition to develop an understanding of the five basic senses.

b. The teacher may dissect a sheep's eye so that the students may observe its parts and compare it with the model of the human eye.

c. Use the diagram of the eye as a class study aid. (See Appendix, p. 257.)

d. Have the class perform the exercise "The Eye and Vision." (See Appendix, p. 259.)

e. Refer to the combinations of stimuli used in some of the previous investigations. The "black box" is an example.

f. Compare the eye to a camera. Use the pin-hole camera available in each school.

g. To demonstrate persistence of vision: Cut out a piece of cardboard two inches square. On one side draw a bird cage, on the other draw a bird and color it red. Slit the eraser of a pencil; insert the card and lock it in position with a pin. Rotate the card. Relate to motion pictures.

h. Discuss the defect in the eye which causes a person to be nearsighted or farsighted, or to have the condition known as astigmatism.

i. Illustrate the three-color theory of vision as follows:

Select six pieces of paper or cardboard about six inches in size, one each of red, orange, yellow, green, blue, and violet. Get as nearly true colors as possible. A box cover or a pamphlet or magazine cover may be just the thing. Select a very white clean wall that is brightly illuminated by the sun or the spot of the picture projector. If the wall is not white, use a large square of white paper attached to the wall as a screen.

Hold the red paper against the bright area of the screen and instruct the students to look at it steadily while you hold it there for about a half minute. Now remove it and have them continue to gaze at the same spot on the white screen. They will see a brilliant green afterimage stand out on the screen.

This behavior helps give support to the three-color theory in this way: While gazing at the red disc on a white background, the red-sensitive nerve endings that lie within the area of the retina which is covered by the red image become fatigued to red and those that sense yellow and blue become rested, for there is no yellow or blue to excite them. As the red object is removed, the rested yellow-sensitive and blue-sensitive nerve endings in that area will respond to the yellow and blue components of the white light from the screen much more intensively than the fatigued red-sensitive nerve endings can respond to the remaining red. So yellow and blue seem to pop right out of the screen, resulting in the beautiful brilliant green that you see.

Practice this until everyone is able to have this visual experience. Then try the other colors and explain their afterimages on the basis

CONCEPTS	RESOURCES
6, 7, 8, 9 (Cont.)	
10. The nervous system serves as a communications network for the human body. 11. The brain and the spinal cord make up the central nervous system; neurons, or nerve cells, form a subdivision known as the peripheral nervous system. 12. The autonomic nervous system controls involuntary action of various body organs (the heart, stomach, and colon, for example). 13. The brain consists of three main parts: the cerebrum, the cerebellum, and the medulla. 14. Many impulses pass through the spinal cord on their way to the brain.	10, 11, 12, 13, 14 The Molecule and the Biosphere, pp. 20-29 FILMSTRIPS Fs 612.8 Human Nervous System TRANSPARENCIES Trns. 612 Anatomy FILMS Fundamentals of the Nervous System, Col., 16 min. Behavior in Animals and Plants, Col., 11 min.
15. Alcohol and narcotics have many and varied effects on the nervous system. a. Alcohol	15 PUBLICATIONS McCarthy, Raymond G., Facts About Alcohol, S.R.A. Inc., 1951. Williams, Jesse F., Alcohol - The Study of a Current Problem, Calif. State Dept. of Educ., 1953. FILMS None for the Road, B./W., 16 min. To Your Health, Col., 10 min. Verdict at 1:32, Col., 20 min. Friendly Enemy, B./W., 24 min. Liquid Lore, Col., 20 min. AUDIO-TAPE (in each school) Facts Known About Alcohol

i. of the three-color theory. After trying all these combinations, it must be clear that the eye seems capable of seeing only three colors (the primary colors, red, yellow, and blue) and that the intermediate colors are interpreted as blends of these three.

10, 11, 12, 13, 14

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Differentiate between instincts, behavior patterns, reflex acts, and habits.

c. Compare man's brain with that of a lower animal.

d. Use a model to show the parts of the brain and spinal column.

15

Information on alcohol and narcotics should be presented in such a way that the student is given a background of scientific information and observations that will enable him to make his own logical, intelligent decisions regarding the use of alcohol and narcotics. This may help to prevent the negative reaction which often results from an emotional, moralizing presentation. Emphasis should be placed on the actual damage done to the human body: physical, psychological, and genetic. More coverage will be provided in the section on preparations for space flight and space medicine.

a-1. The film "Friendly Enemy" depicts several experiments and demonstrations with alcohol, some of which might be appropriate for classroom use.

a-2. A demonstration comparing the properties of water and alcohol can be used. Place in each of three test tubes 3/4 ounces (21.3 cm^3) ethyl alcohol (about the amount of alcohol in one jigger of whiskey or one glass of wine or one can of beer). Put the same amount of water (3/4 oz.) in each of three test tubes. Pair the tubes up (one alcohol with one water). In the first pair, place equal amounts of any oil. Shake well and let stand. Proceed with next step and return later.

In the second pair of test tubes, drop a cube of fresh bread and let stand. In the third pair, put a small quantity of raw egg white. Check the oil. The alcohol and oil will look quite different from the oil and water. Remove the bread from the water and drop on a table top from two to three feet. Do the same with the bread from the alcohol. Shake the egg solutions and show the difference.

CONCEPTS	RESOURCES
15 (Cont.)	
b. Narcotics	PUBLICATIONS *Drug Abuse: A Source Book and Guide for Teachers*, California State Department of Education, 1967. *Basic Life Science* "Abuse of Codeine Cough Syrups--A Medical Viewpoint," an article by Dr. Maurice H. Seevers. "Background Information on Drug Abuse," a compilation of papers distributed by San Diego City Schools, May, 1967. "California Faces the Drug Abuse Problem," State of California Interdepartmental Committee on Narcotics, 1963. "Darkness on Your Doorstep," Los Angeles County Board of Supervisors. "Don't Get Stuck," San Diego County Probation Department. "Drug Abuse: the Empty Life," Smith-Kline and French Laboratories, 1965. "Facts About Narcotics and Other Dangerous Drugs," Victor H. Vogel. SRA, 1967. "Fight Against Addiction--A Pioneering Approach," State of California, Department of Corrections, Youth and Adult Corrections Agency, reprinted from *San Diego Law Review*, January, 1965. "Laws For Youth," Juvenile Protection Committee, San Diego County. "LSD: Teacher Resource Material for Health Education Classes in Senior High Schools," Los Angeles City Schools, Physical and Health Education, Safety, and Youth Services Branch, Instructional Bulletin No. SC-40, 1966. "Medicinal Naracotics: Facts on Benefits and Controls," Pharmacautical Manufacturers Association, 1965. "Narcotics: The Study of a Modern Problem," Jesse F. Williams, California State Department of Education, 1952.

Pour some of the water from the bread test tube on a metal or formica table top and attempt to light it. Do the same with a very small quantity of alcohol from the bread demonstration. This last demonstration is very effective with the lights dimmed in the classroom.

b-1. Drug Abuse is currently the most up-to-date publication available as a source book. Pages 1-114 give information for teacher background and classroom discussion. Pages 115-124 give questions and answers which could be used for evaluation of student knowledge on the subject. Pages 125-131 present a very comprehensive bibliography for teacher reference. Selected articles could be used for reports by students and enrichment studies.

b-2. Care should be taken to emphasize data included in this unit as examples of knowledge collected through scientific research over many years.

b-3. Most of the pamphlets and articles listed will be available in the schools in the fall of 1967. Additional material of a more up-to-date nature should be continuously gathered by the teacher. Updating of information is vital if this ever-changing problem is to be treated from the scientific standpoint. The pamphlets are listed alphabetically with no attempt made to rank them in importance.

b-4. Additional resource materials will be distributed by the Science Specialist's office.

b-5. Science News, Vol. 91, June 3, 1967, p. 518, presents information concerning genetic damage caused by LSD. See current literature for the latest research.

CONCEPTS	RESOURCES
15 (Cont.)	"The Narcotic Problem: A Brief Study," State of California, Department of Justice, Bureau of Narcotic Enforcement, 1965. "No Secret: A Compilation of Information on Narcotics and Dangerous Drugs," San Diego City Schools, Curriculum Services Division, May, 1967. "State of California, Narcotic Act," Department of Justice, Division of Criminal Law and Enforcement, 1965. FILMS Drugs and the Nervous System, Col., 18 min. AUDIO-TAPE (in schools) Dr. Ungerleider and Dr. Fisher on LSD.
16. Science is a way of perceiving. 17. Scientists solve problems and make discoveries by making contact, detecting energy, transmitting energy, and receiving energy. 18. Science also involves interaction--a give-and-take experience between two persons or between a person and the conditions of his environment.	16, 17, 18 The Molecule and the Biosphere, pp. 29-37, 40-42 The Atom and the Earth, pp. 19-21 FILMS Scientific Method in Action, Col., 19 min. Scientific Method, B./W., 11 min. Using the Scientific Method, B./W., 11 min. Science and Technology, Col., 16 min.

16, 17, 18

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Select a simple problem and have the class write down the steps used in solving it. Then have each pupil select a problem he has had to solve (e.g., buying a new sweater) and compare the steps he used with the steps on the list. Various sample problems are included in the Appendix. Many of these could be home assignments (as identified). Many teachers may wish to place the instructions on a 3 x 5 card (without the explanation, of course) for the student to take home, perform, and solve, using the scientific process.

c. Select some problem that can be solved in class and have the students suggest the possible steps to be used in solving it by the scientific process (e.g., what kind of plant food would be best for African violets?). Follow the method suggested by the class and approved as good scientific procedure. Stress the purpose of a control; the need for accurate observations, measurements, and records; and the reasons for repeating an experiment.

d. Present the class the following situation: Display a pitcher of ice water. Note the appearance of drops of water on the outside of the pitcher.
   1. List those facts which you think are related to the observed phenomena.
   2. Theorize as to whether the moisture on the pitcher comes from the water inside or from the air outside.
   3. Substantiate your theory by gathering more facts.

CONCEPTS	RESOURCES
19. The individual investigation, perhaps in the form of a science project, is a valuable experience in understanding the ways in which scientists work.	19 FILMS Science Project, Col., 14 min. Science Fair, Col., 14 min.
20. Studies of science and mathematics are closely related. Mathematics is an important tool of the scientist. 21. The metric system of measurement is used internationally by scientists.	20, 21 The Molecule and the Biosphere, pp. 44-47. Basic Physical Science, Lab Manual. Lab 2, pp. 4-5; Lab 18, pp. 42-43 FILMSTRIPS Fs Box 389 Measuring (5-Fs)

19

a. Have the class make suggestions for simple experiments that each student might do at home. Select several appropriate and safe experiments and assign them to be done and reported on to the class. This procedure can serve as a good springboard toward developing a science fair project. Show the film "Science Fair" or "Science Project" to further stimulate interest in project development.

b. Have each student select some problem to be solved by careful observations at home; e.g., the location in his yard or house where certain plants grow best, or the numbers and kinds of birds that visit his yard.

c. In the periodical, Science World, some of the problems students have attempted to solve.

d. Read to the class about the work of Sir Alexander Fleming or Louis Pasteur. Discuss the steps used in solving one of the problems or in making one of the discoveries.

20,21

a. Some of the basic exercises utilizing the metric system that are suggested below might be interspersed in the preceding sections as the instructor feels they might apply.

b. Students should definitely learn the basic features of the metric system, but at the junior high level have little need to convert from English to metric units or vice versa. Therefore, the use of the metric system itself and scientific notation will best prepare the student for his work in junior high.

c. The lab investigations in the lab manual for the Singer Series, Basic Physical Science, provide several activities on the metric system and one exercise on scientific notation. (Lab 2, pp. 4-5, 69; Lab 18, pp. 42-43, 79-80.)

d. Other exercises and suggested activities appear in the Appendix, pp. 261-67.

e. Stress the use of graphs. An activity such as the one listed below will provide experience in graph use and interpretation.

Plot a graph which relates a student's age to his height. Assume that at birth, you, the student, measured one foot six inches. Estimate how tall you will be at age twenty.

1. What facts are evident in the graph? Apply them to the problem.
2. Theorize as to your height at age twenty.
3. List several facts which might influence your theory.
4. List those things which might interfere with your theory.
5. Have you carefully selected all data in this problem, or is there really more than one problem involved?

f. The filmstrip set "Measuring" includes one strip on the metric system.

CONCEPTS	RESOURCES
22. Familiarity with available materials and the application of good study habits will increase the student's success in his science studies.	

22

a. Through class discussion, bring out the necessity and value of developing good study habits now.

b. Have the class practice using the parts of a book (Table of Contents, Index, Glossary, etc.). Emphasize importance of recency of science books, indicated by copyright date.

c. Help the class make a model outline of a short article from Science Digest or some other magazine.

d. Librarians generally prefer to review library procedures with classes. Students with problems to solve (such as written reports or projects) may find this a valuable experience. Scheduling may have to be postponed until library is available.

Suggested Topics for Student Investigations and Research Projects

Students may wish to choose one of the following topics for more detailed study and investigation.

- The role of science in overcoming superstitions and the importance of getting information from reliable sources.
- The relationship of the work of a professionally-trained person such as a scientist, engineer, or medical specialist to the various sciences.
- The training requirements for careers in the various sciences, engineering, and technology. The United States Office of Education pamphlet, "Science and Your Career," 1962, is available free of charge from the United States Department of Labor, Bureau of Labor Statistics, 341 Ninth Avenue, Room 1025, New York 1, N. Y.
- Kinds of timing devices used to measure short time intervals such as microseconds.
- Instruments used for measuring distances too small to be measured under a microscope.
- The number of science-related articles in the daily newspaper compared with the number ten years ago.
- The present need for professionally-trained scientists, engineers, and technologists compared with that of ten years ago; the estimated need for the next ten years.
- Science's influence on my parent's occupation.
- History of the microscope.
- Metric system for the United States.
- Alcohol.
- Smoking.
- Heart Disease.
- Emphysema.
- Cancer.
- Drug abuse.
- LSD.
- Addicting drugs.
- Narcotics laws.

Teacher's Evaluation *

A Guide for Teaching General Science 1-2 (8th)

UNIT I

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

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2. List any titles which should be added to the audio-visual list.

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3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

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4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

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5. Which work sheet should be deleted or changed?

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6. What additional work sheets should be added to this unit? Please describe or submit draft.

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7. Other suggestions.

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*Please fill out this form after the unit is completed. Completed forms should be sent to the Science Specialist, Room 2041, Education Center, at the end of each semester during the school year 1967-68.

UNIT II

LIFE IN A PHYSICAL WORLD

UNIT II

LIFE IN A PHYSICAL WORLD

(4 to 5 Weeks)

Goals of the Unit

During his study of this unit, the student realizes that the study of matter is basic to the understanding of all natural phenomena. He is presented an overview of matter, mass, weight, inertia, compounds, mixtures, and the Periodic Table of the Elements. This background leads him directly into the study of protoplasm, living cells, and the various ways protoplasm may be organized into living cells. The student should easily understand the inter-disciplinary contributions of biology, chemistry, and physics to the study of living cells that are stressed throughout the four chapters in this unit.

Teaching Suggestions

This particular unit follows the basic textbook, The Molecule and the Bioshere, Chapters 2, 3, 4, and 5, with little variation. A variety of audio-visual aids, supplementary materials, and suggested student activities are coordinated with the "Concepts of be Developed" on the following pages.

It is recommended that the teacher not move too deeply into the study of electron structure and the Periodic Table of the Elements in this unit; these topics are returned to later in the course.

Teachers may find it desirable to start some student teams on Investigation 4, textbook, page 96, and other teams on Investigation 5, textbook, page 122, at the same time. Each of these investigations runs over a period of several days. Chapters 4 and 5 might then be studied together as the teacher sees ways to integrate them with available materials.

The teacher should plan to start bean seedlings at the beginning of this unit and arrange for elodea leaves in order to have them available for use in Chapter 4 (approximately 2 weeks into unit). Other needed living materials may be brought in by students or provided by the teacher as needed (onions, leaves, etc.).

Books Referred to in This Unit

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the Physical Sciences. New York: Harcourt, Brace and World, Inc., 1961

MacCracken, Helen D., et. al. Basic Life Science. Chicago: The L. W. Singer Company, 1964.

MacCracken, Helen D., et. al. Basic Physical Science. Chicago: The L. W. Singer Company, 1964.

Morholt, Evelyn, et. al. Teaching High School Science: A Sourcebook for the Biological Sciences. New York: Harcourt, Brace and World, Inc., 1958.

Navarra, John G., et. al. Today's Basic Science: The Molecule and the Bioshere. New York: Harper and Row, 1965.

Ploutz, Paul F., et. al. Laboratory Manual: Basic Physical Science. Syracuse, New York: L. W. Singer Company, 1964

Concepts to be Developed

CHAPTER 2

1. Matter, energy, and life are closely linked.
2. Life is difficult to define; it involves a series of processes, or applications of energy.
3. Life is a condition of organisms.
4. Energy is a capacity, or an ability; it is the ability to do work.
5. Matter is anything that has mass and takes up space.
6. There are three states of matter: solid, liquid, gas.
7. Mass and weight are not the same; weight is a measure of the pull of gravity; mass is the amount of matter an object contains.
8. Inertia is the tendency of a body at rest to remain at rest and of a body in motion to remain in motion.
9. The greater the mass of a body, the greater is the inertia of the body.
10. A substance is a particular kind of matter having specific properties.
11. An element is a pure substance that cannot be broken down into other substances by *ordinary chemical* means.
12. An isotope of an element differs from another isotope of the same element in the number of neutrons it contains and in atomic weight.
13. A compound is a combination of two or more elements.
14. A molecule is the smallest whole piece of a particular substance; there are molecules of elements and molecules of compounds.
15. A physical change alters the state, shape, size, position, or other observable properties of matter, but it does not affect the makeup of the substance.
16. A chemical change produces new substances; the original substance turns into something else when it undergoes a chemical change.

CHAPTER 3

17. Protoplasm is living matter.
18. As living matter, protoplasm is always changing; it is not a definite, fixed substance.
19. Protoplasm consists mostly of water; it also contains mineral solids and carbon compounds.

20. A chemical bond joins the atoms that make up a molecule.

21. Atoms either transfer electrons or share electrons to form a chemical bond.

22. Carbon joins readily with other elements because the carbon atom can form four bonds.

23. Organic chemistry is the study of carbon compounds.

24. About 15 percent of protoplasm consists of protein.

25. Proteins are body builders; they are a necessary part of the diet.

26. Proteins are made up of amino acids.

27. Nucleic acids control biochemical reactions within the cell.

28. There are two kinds of carbohydrates: sugar and starch.

29. All carbohydrates are made up of carbon, hydrogen, and oxygen.

30. Carbohydrates release energy when they break down in the digestive process.

31. Sugars and starches are fuel nutrients.

32. About 13 percent of protoplasm is made up of fats.

33. Energy is released when fat is broken down in the digestive process.

34. Fat is a fuel nutrient.

CHAPTER 4

35. One of the most important theories of science is the cell theory.

36. The cell theory is a statement that all living things are composed of cells; cells are the "building blocks" of living things.

37. All cells differ from one another, but there are also basic similarities among cells.

38. Being alive, a cell is never at rest; it is a changing, reacting unit of a living thing.

39. Every cell consists of two basic subdivisions: the nucleus and the cytoplasm.

40. Tobacco is a substance used by man that has several harmful effects on living cells.

41. Cells tend to be spherical, but they are usually jammed together and flattened.

42. Most cells are small; the relationship between the nucleus and the cytoplasm seems to limit their growth.

43. Large organisms do not as a rule have larger cells than do small organisms; large organisms simply have more cells than do small ones.

44. Cytology is a study of the cell.

45. The cytologist employs various methods and tools in his study of the cell.

46. An electron microscope forms an image with electrons instead of with light waves.

CHAPTER 5

47. The world of living things consists largely of microorganisms.

48. A one-celled organism is not necessarily simple in structure and function; it may have achieved a high level of organization.

49. Some one-celled organisms exhibit little internal specialization; others are highly specialized.

50. Microorganisms can easily be cultured and observed.

51. Many lower forms of life are many-celled; all higher forms of life are many-celled.

52. The cells of higher forms of life are grouped into three levels of structure and function: (1) tissues, (2) organs, and (3) systems.

53. There are five basic kinds of tissues in the higher organisms: (1) epithelial, (2) muscle, (3) connective, (4) nerve, and (5) blood.

54. Some of the five main kinds of tissues are further divided into subtypes.

55. Tobacco, when used by man, has specific harmful effects on the respiratory system, the digestive system, the blood, and reproduction.

Resources and Activities

CONCEPTS	RESOURCES
UNIT INTRODUCTION	Introduction The Molecule and the Biosphere, p. 49 FILM Microscope and Its Use, B./W., 10 min.
CHAPTER 2 1. Matter, energy, and life are closely linked. 2. Life is difficult to define; it involves a series of processes, or applications of energy. 3. Life is a condition of organisms. 4. Energy is a capacity, or an ability; it is the ability to do work.	1, 2, 3, 4 The Molecule and the Biosphere, pp. 51-57 FILMS What's Alive?, Col., 11 min. Matter and Energy, B./W., 10 min. Energy and Its Forms, Col., 11 min. Energy and Work, Copy B, Col., 11 min. FILMSTRIPS Fs 574 Introducing Biology (26 Fr.) Fs 530.1 Energy (41 Fr., Manual)

Unit Introduction

a. Refer to the teacher's edition, page 23.

b. Plan a bulletin board stressing energy, matter, and the cell.

c. Suggest ways of categorizing the sciences. Refer to page 49 in student text, page 26 in teacher's edition of basic text, and the Appendix of this guide, page 253 for information.

d. Organize the class into groups and do Investigation 2, student text, page 50. Instruction in the use of the microscope, text, pages 42-44, should be stressed here if not done earlier.

1, 2, 3, 4

a. Refer to teacher's edition, pages 25-27, for background and suggestions to present this section.

b. Special note: The first paragraph, second column, page 55 in student text is very misleading. (May be reworded in state printing of text.)

c. Ask the class to gather evidence to prove that each of the following life functions occur in both animals and plants: growth, motion, digestion, reproduction, response to stimuli, respiration, and elimination of wastes.

d. Observe whether a candle flame illustrates the same functions listed in "c" above. Is it a living thing?

e. Place a few scraps of fine copper wire on a slide, and mount under a microscope or microprojector. Now add a drop of silver nitrate and watch the "growth" of crystals. Compare this with growth as applied to living things.

f. Be sure that students know and understand that work is measured independent of time.

g. Compare the amount of force needed to overcome friction in moving an object across a surface as compared to lifting it.

h. Work out some problems involving the calculation of work and power.
Examples:
(1) How much work is done by lifting 20 pounds five feet?
(2) Is work done when a force is exerted against some object and the object is not moved?
(3) What is the horsepower of an engine that will raise 1100 pounds 20 feet in two seconds?
(4) Two boys carry the same load up a flight of stairs 20 feet high; one does it in five seconds and the other in ten seconds: Do both boys do the same amount of work? Do both develop the same power?

i. Relate force, work, and energy. Discuss the terms "newton" and "dyne."

CONCEPTS	RESOURCES
5. Matter is anything that has mass and takes up space. 6. There are three states of matter: solid, liquid, gas. 7. Mass and weight are not the same; weight is a measure of the pull of gravity; mass is the amount of matter an object contains. 8. Inertia is the tendency of a body at rest to remain at rest and of a body in motion to remain in motion. 9. The greater the mass of a body, the greater is the inertia of the body.	5, 6, 7, 8, 9 The Molecule and the Biosphere, pp. 58-60 A Sourcebook for the Physical Sciences, mass, p. 22; inertia, p. 23, 359-62 FILMS Temperature and Matter, Col., 15 min. Solids, Liquids and Gases, B./W., 10 min. Explaining Matter: Molecules in Motion, Col., 11 min. FILMSTRIPS Fs 530.1 All Matter Has Three Forms, (42 Fr.) Fs 530.1 Gravity (43 Fr.) Fs 536.41 How Heat Causes Expansion, (37 Fr.)

5, 6, 7, 8, 9

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Demonstrate molecular motion using the molecular motion demonstration tube which consists of a glass tube containing mercury and glass particles. Heating this mercury vaporizes it whereby the glass particles are made to bounce about, seemingly without provocation. Relate this demonstration to the addition or removal of heat as a means of changing matter from one state to another.

c. Use an overhead projector to help develop the concept of particle position and velocity in the states of matter. Obtain a supply of marbles and three clear plastic boxes of unequal sizes. Into the smallest box put as many marbles as can be packed into a single layer. Put an equal number of marbles into each of the remaining boxes. Set each box on the stage of the overhead projector. Gently jiggle each box so that the marbles move. Note the degree of movement and the distance between the marble particles in each case. Relate the demonstration to particles in states of matter. (Best results for illustrating the gaseous state can be obtained when the box is much larger than those used to represent the other two states.)

d. Temperature and changes of state:

1. Have pupils place some crushed ice into a 150-ml. beaker. Support a thermometer so that its bulb is buried in the crushed ice. At one-minute intervals, have the pupils read and record the temperature and note the states of matter seen in the beaker at the time of each reading. Continue to take the temperature after the ice has disappeared. The data may be graphed with temperature on the y-axis and the time on the x-axis. The graph will be a horizontal line during the change of state since any heat absorbed by the ice is used to rearrange the molecules for the liquid state. After all the ice has melted, the temperature will rise at a fairly uniform rate. Details of the latent heat of fusion can be found in physics textbooks. (The time required for this activity can be decreased by setting the beaker of ice in a dish of hot water.)

2. Teacher demonstration: Support a 500-ml. Pyrex Florence flask on a ring stand clamp above the flask, hang two thermometers so that the bulb of one is in the water and the bulb of the other is up in the neck of the flask. Heat the unstoppered flask and its contents. As the water boils, compare the reading of the two thermometers over a period of two or three minutes. (UNDER NO CIRCUMSTANCES PUT THE THERMOMETERS INTO A STOPPER INSERTED IN THE FLASK; DANGEROUS PRESSURE WILL BUILD UP.)

e. Demonstrate inertia with the Inertia Apparatus.

f. Demonstrate inertia by suspending a heavy weight, such as a bundle of books or a small sandbag, from the midpoint of a thin string. Pull steadily on the bottom of the string; it will break above the weight. But if you pull the bottom of the string suddenly, the string will break below the weight because of weight's inertia.

CONCEPTS	RESOURCES
9. (Cont.)	
10. A substance is a particular kind of matter having specific properties. 11. An element is a pure substance that cannot be broken down into other substances by ordinary chemical means. 12. An isotope of an element differs from another isotope of the same element in the number of neutrons it contains and in atomic weight. 13. A compound is a combination of two or more elements. 14. A molecule is the smallest whole piece of a particular substance; there are molecules of elements and molecules of compounds.	10, 11, 12, 13, 14 The Molecule and the Biosphere, pp. 61-71 FILMS Evidence for Molecules and Atoms, Col., 19 min. Structure of Atoms, Col., 13 min. Explaining Matter: Atoms and Molecules, B./W., 14 min. FILMSTRIPS Fs 539.1 Structure of Matter (68 Fr.) Fs 539.14 Composition of Atoms (49 Fr.) Fs 541.2 Molecules, Atoms, and Simple Reactions, (48 Fr.) Fs 541 What Are Elements and Compounds? (52 Fr., Manual)
15. A physical change alters the state, shape, size, position, or other observable properties of matter, but it does not affect the makeup of the substance. 16. A chemical change produces new substances; the original substance turns into something else when it undergoes a chemical change.	15, 16 The Molecule and the Biosphere, pp. 71-73 A Sourcebook for the Physical Sciences, pp. 28-32

g. Refer to Laboratory Manual; Basic Physical Science, for the following activities:
   Lab 6, Effects of Temperature on Matter, pages 14-16.
   Lab 7, Transformation of Energy, pages 17-18.

10, 11, 12, 13, 14

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Exhibit and discuss samples of elements and compounds.

c. Refer to Laboratory Manual; Basic Physical Science, for the following activity:
   Lab 5, Periodic Table, pages 11-13, 92.
   Page 269 of the Appendix of this guide is a blank Periodic Table outline that could be filled out by all students or by one student and reproduced for the class. Students may want to color it as per text page 65 and save it for Unit VII.

d. Observe Brownian Movement by viewing homogenized milk or particles of carbon in India ink under the microscope. Set up the Brownian Movement apparatus and observe carbon particles from smoke.

e. Place a small quantity of ether or oil of wintergreen in a watch dish to demonstrate the diffusion of molecules throughout the classroom. A small crystal of potassium permanganate or copper sulfate dropped through a glass tube into the bottom of a 1-liter graduate filled with water will demonstrate diffusion in liquids. Discuss the possibility of convection rather than diffusion as the cause.

f. Demonstrate the interspersion of molecules by adding 50 ml of alcohol to 50 ml of water. The volume will be less than 100 ml.

g. Make models (or have class members do so) of simple atoms using directions in CER kit "Solid State Physics." Also use charts from this kit.

h. Perform laboratory investigation, "Matter: Elements, Compounds, and Mixtures," in place of or in addition to text activities. See Lab 3, Laboratory Manual; Basic Physical Science.

i. Refer to various examples of colloids such as fog (liquid in gas), whipped cream (gas in liquid), smoke (solid in gas), and ink (solid in liquid).

15, 16

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Use student investigation "Physical and Chemical Changes," Appendix, page 271 and/or refer back to or use at this point the student investigation, "Effects of Temperature on Matter," Laboratory Manual; Basic Physical Science.

c. Several interesting demonstrations of physical and chemical changes are suggested on pages 28-32, of A Sourcebook for the Physical Sciences.

CONCEPTS	RESOURCES
CHAPTER 3	
17. Protoplasm is living matter. 18. As living matter, protoplasm is always changing; it is not a definite, fixed substance. 19. Protoplasm consists mostly of water; it also contains mineral solids and carbon compounds.	17, 18, 19 The Molecule and the Biosphere, pp. 77-83 Basic Life Science, pp. 264-67, 316-30 A Sourcebook for the Biological Sciences, p. 36 Dairy Council of California for current list of materials available, write or phone: Dairy Council of California, 4604 University Avenue, San Diego, California FILM Food: The Color of Life, Col., 22 min. FILMSTRIP Fs 613.2 Food for Life, (65 Fr., Manual)
20. A chemical bond joins the atoms that make up a molecule. 21. Atoms either transfer electrons or share electrons to form a chemical bond. 22. Carbon joins readily with other elements because the carbon atom can form four bonds. 23. Organic chemistry is the study of carbon compounds.	20, 21, 22, 23 The Molecule and the Biosphere, pp. 84-85 Basic Physical Science, pp. 171-85 FILMS Carbon and Its Compounds, Col., 10 min. Hydrocarbons and Their Sturctures, Col., 14 min. FILMSTRIPS Fs 546.68 Carbon (29 Fr.) Fs 547.4 Hydrocarbons (39 Fr.)

17, 18, 19

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Investigation 3, page 76 of student text, gives a good introduction to the materials contained in protoplasm.

c. Use Dairy Council charts and reference materials to emphasize these concepts. (Many items are available in class sets.)

d. Refer to Basic Life Science, pages 264-67 and 316-30, for additional background reading for student enrichment.

e. A summary of nutrient tests that may be performed by students or presented as demonstrations also appears on page 36 of A Sourcebook for the Biological Sciences.

Note: Defer tests for protein, carbohydrates (starch and sugar), and fats. They appear later in this chapter.

20, 21, 22, 23

a. Use activities suggested in the text and the teacher's guide to develop these concepts.

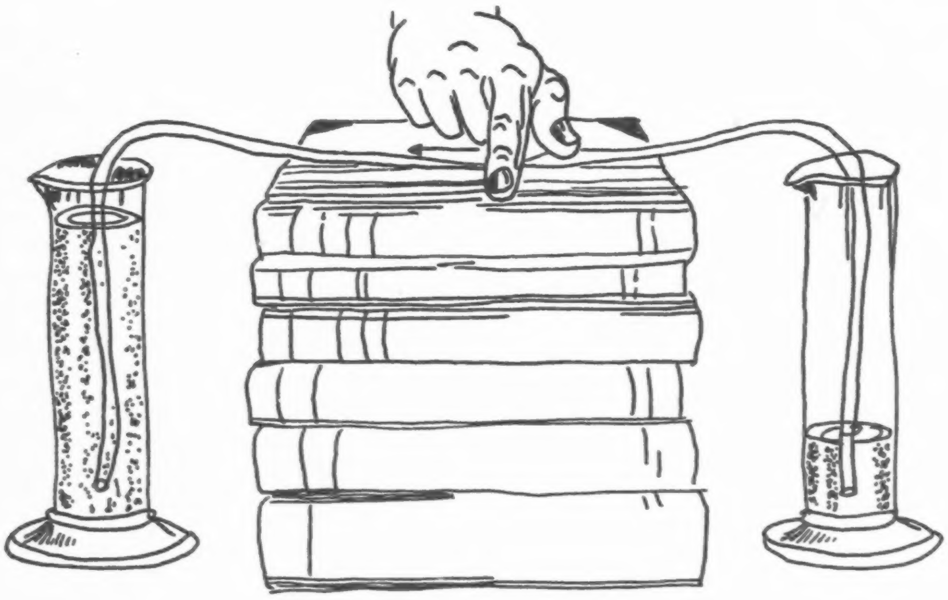
b. Use Molecular Model Set (Non-stock MOL-9080) to demonstrate formation of carbon compounds. (See teacher's guide with kit.)

c. Do not spend too much time on these concepts; they will be returned to later.

d. The teacher should preview the film "Hydrocarbons and Their Structures" to determine its suitability for particular groups.

CONCEPTS	RESOURCES
	20, 21, 22, 23 (Cont.)
24. About 15 percent of protoplasm consists of protein. 25. Proteins are body builders; they are a necessary part of the diet. 26. Proteins are made up of amino acids. 27. Nucleic acids control biochemical reactions within the cell.	24, 25, 26, 27 The Molecule and the Biosphere, pp. 86-88 Basic Life Science, pp. 330-32, 334-35
28. There are two kinds of carbohydrates: sugar and starch. 29. All carbohydrates are made up of carbon, hydrogen, and oxygen. 30. Carbohydrates release energy when they break down in the digestive process. 31. Sugars and starches are fuel nutrients.	28, 29, 30, 31 The Molecule and the Biosphere, pp. 89-92 Basic Life Science, pp. 332-34

e. A working model illustrating the principle of peristalsis can be set up in a few seconds in the following way:
Fill a drinking glass or similar vessel with water. Insert a piece of gum rubber tubing, draw water into it and allow the water to flow into a second glass through the siphon. The water in both glasses will soon reach the same level.
Now place a few books between the glasses, stroke across the tubing with a finger and keep stroking in one direction to simulate waves of peristalsis. Watch the change of the water level of the two glasses.



24, 25, 26, 27

a. Use activities suggested in the text and teacher's guide to develop these concepts.

b. It is recommended that the test for protein (Experiment, page 86 in text) be done as a student demonstration. Individuals may wish to test other foods as a research investigation. (EYE PROTECTIVE DEVICES REQUIRED.)

c. Models of simple protein molecules may be made with the Molecular Model Set referred to above.

28, 29, 30, 31

a. Use activities suggested in the text and teacher's guide to develop these concepts.

b. It is recommended that the tests for sugar (Experiment, page 91 in text) (EYE PROTECTIVE DEVICES REQUIRED) and starch (Experiments, pages 92-93 in text) be done as student demonstrations. Individuals may wish to test other foods as a research investigation.

c. Models of simple carbohydrate molecules may be made with the Molecular Model Set referred to above.

CONCEPTS	RESOURCES
32. About 13 percent of protoplasm is made up of fats. 33. Energy is released when fat is broken down in the digestive process. 34. Fat is a fuel nutrient.	32, 33, 34 The Molecule and the Biosphere, p. 93 Basic Life Science, pp. 325-28
CHAPTER 4	
35. One of the most important theories of science is the cell theory. 36. The cell theory is a statement that all living things are composed of cells; cells are the "building blocks" of living things.	35, 36 The Molecule and the Biosphere, pp. 97-98 Basic Life Science, pp. 36-38
37. All cells differ from one another, but there are also basic similarities among cells. 38. Being alive, a cell is never at rest; it is a changing, reacting unit of a living thing. 39. Every cell consists of two basic subdivisions: the nucleus and the cytoplasm.	37, 38, 39 The Molecule and the Biosphere, pp. 99-110 Basic Life Science, pp. 38-40, 108-14, 218-19 FILMS Life in a Cell, Col., 14 min. Cell: Structural Unit of Life, B./W., 10 min. Characteristics of Plants and Animals, Col., 10 min. FILMSTRIPS Fs 574.8 Introducing Cells (30 Fr.)

32, 33, 34

a. Use activities suggested in the text and teacher's guide to develop these concepts.

b. It is recommended that the test for fat (Experiment, page 93) be done as a student demonstration and the results then passed around the class. Individuals may wish to test other foods as a research investigation.

c. If time permits, a discussion of polyunsaturated, monounsaturated, and saturated fats may be based on the material on pages 325-28 in Basic Life Science.

35, 36

a. Use activities suggested in the text and teacher's edition to intorduce this chapter and develop these concepts.

b. Have student teams begin Investigation 4, page 96 in text. (See also background in teacher's edition, pages 56-57.)

37, 38, 39

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Sets of 12 microscopes may be ordered from the Instructional Aids Distribution Center for one-week periods. Microscopes should be arranged for during the study of this unit in order that all class members be given a chance to do microscope work. Additional microscopes and dissecting microscopes are also available in each school.

c. A student who draws well may want to enlarge the drawing of the living cell on page 109 of the text as a class poster.

d. Slides (2" x 2") are available in each school that illustrate various cell structures; a slide projector is available in each science department.

e. Explano-Mount Microscope Slides of a variety of organisms or structures are available in each school. The teacher might select certain ones pertinent to these concepts and assign them to students who finish their other work early.

f. The bioscope might be used by students to show groups of their classmates particularly good slides they have prepared.

g. Be sure to refer the students to pages 145-149 in the text for information on how to prepare slides. The method of sectioning shown on page 149, should be easy for the students to do.

h. Have students build a model of a cell from a small plastic pill box. Plastic clay or similar material may be used to form the nucleus and other parts.

CONCEPTS	RESOURCES
40. Tobacco is a substance used by man that has several harmful effects on living cells.	40 "Teaching Kit for Smoking Education" Content Suggestions, b. and c. Tobacco Leaf (1) The tobacco leaf is made up of a mixture of several hundred chemical substances. (2) Most of these substances have been found in other plants; so far however, two groups, of which the alkaloid nicotine is one, have not been discovered in other natural sources. Tobacco Smoke (1) Tobacco smoke is made up of a mixture of gases, uncondensed vapors and small liquid particles. The condensate from cigarette smoke is called tar, a complex mixture of many chemicals. (2) The chemicals in tobacco smoke of the greatest medical importance are: -Nicotine - a poison which in large doses will cause convulsions and death because of respiratory failure. -Carcinogenic substances - about 16 of these have been identified in experimental animals. Painting tars on the skin of mice over a period of time has produced skin cancers. -Irritants - such as phenols, aldehydes, ketones, ammonia, and volatile acids. -Carbon monoxide - a deadly poison in sufficient amounts. The amount inhaled while smoking is usually not sufficient to give obvious effects directly attributable to carbon monoxide. By combining with the hemoglobin in the red blood cells, carbon monoxide reduces the oxygen-carryin capacity of the blood.

ACTIVITIES

40

a. The "Teaching Kit for Smoking Education" will be distributed to each teacher in September, 1967 by Smoking Research/San Diego. Certain materials will also be provided in class sets per school. The activities listed below refer to this kit, unless otherwise indicated. Films listed are available from the Instructional Aids Distribution Center unless otherwise noted.

b. Demonstrate collection of tars from tobacco, and their effect on goldfish or guppies. (See p. 57 for directions.)

CONCEPTS	RESOURCES
40. (Cont.)	-Arsenic - may be carcinogenic or co-carcinogenic. It is found in insecticides used by tobacco growers. Content Suggestions, d. and e. (3) Smoking decreases the flow of blood to the retina causing, in some people, a condition called tobacco amblyopia. Night vision is especially affected. (4) Nicotine in low concentrations stimulates the sympathetic ganglia while it paralyzes them in high enough concentrations. Though the parasympathetic ganglia are less sensitive to this effect, they respond in the same manner. Central Nervous System and Autonomic Nervous System (1) Until tolerance for tobacco is developed, smoking causes nausea, possibly by its effect on the vomiting center in the medulla of the brain. (2) Until tolerance for tobacco is developed, smoking causes dizziness and and unsteadiness by affecting the system in the brain responsible for maintaining equilibrium. The Vascular System (1) Acute cardiovascular effects of smoking are similar to those arising from the stimulation of the sympathetic nerves. (2) Smoking causes an increase in the heart rate and blood pressure. (3) Smoking causes a decrease in the blood flow to the skin due to constriction of the blood vessels of th skin. (4) In Buerger's Disease, which is a di order causing poor circulation from irritation and inflammation of the

b. (Continued)

Equipment and supplies:

Flask with a two-hole stopper
Half-gallon jar with a two-hole stopper
Bucket or pan
Regular cigarettes
Delivery tubes
Cigarette holder

Procedure:

1. Assemble the cigarette tar separating apparatus as shown in the diagram.

2. Fill the small jar half-full of water.

3. Fill the large jar to the top with water.

4. Place a cigarette in the intake and light it.

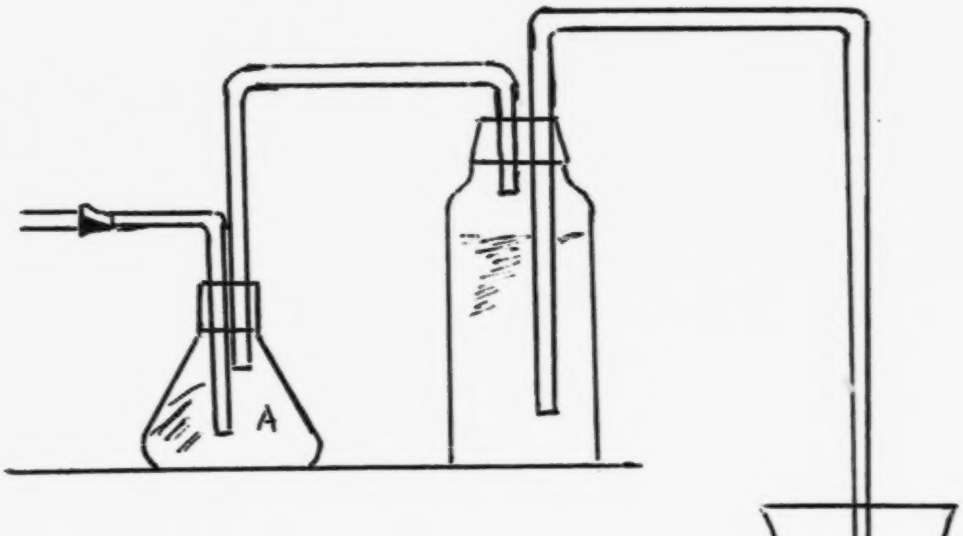
5. Start the siphon action from the large jar into the bucket.

6. The tars will collect in the water in the small jar.

7. Allow the cigarette to burn completely; add more water to the jar if necessary to maintain suction.

8. Examine the water in the collecting jar. Smell this liquid. What color do you note?

9. A goldfish or guppy could be placed in the water in jar A, thus compelling it to absorb cigarette smoke into its body. It usually takes three cigarettes to make the fish lose its equilibrium.



(2)

CONCEPTS	RESOURCES
40. (Cont.)	blood vessels in the arms and legs, patients are forced to stop smoking because smoking causes aggravation of the symptoms.

c. An effective demonstration showing the tars that are inhaled into the mouth and and lungs of a cigarette smoker appears as Experiment No. 2 in the Teaching Kit for Smoking Education. Of particular interest will be the difference in the amounts of tar in the inhaled smoke and in that smoke which is merely held in the mouth. This experiment is not to be performed in the classroom. If the teacher desires to present this idea, he should tell the students to have an adult acquaintance who smokes demonstrate this for the student at home.

d. Demonstrate the effect of nicotine on animal cells.

Materials: Microscope, slide, cover slip, jar of pond water, tobacco solution.

Procedure: Order some protozoans from a biological supply house or obtain some from pond water and prepare a slide of them. Examine under low power of the microscope, noting the movement of the protozoans. Add a drop of tobacco solution to the slide. See activity "b" above for preparation of the tobacco solution (or prepare it by crushing a cigarette in a small amount of water). Observe what happens when a drop of the tobacco solution is added to the slide containing the protozoans.

e. Demonstrate the effects of tars on plants as follows:

Grow some lima bean seedlings (or corn, sunflower, or peas will do) and Paint the stems of the seedlings with a diluted tar solution (see activity "d" above, for preparation of this solution). This will cause the growth of irregular masses of cells. A solution of ammonia in water may be used in place of the tar solution.

f. If students have tried smoking at one time or another, get them to recall the effects their first smoke had on them. Discuss how scientists might have gone about obtaining information on the physiological effects of tobacco and tobacco smoke.

g. Discuss how the cardiovascular effects of smoking might harm a person who is already suffering from heart disease. A good demonstration of the effect that smoking has upon the heart rate appears as Experiment No. 5 in the Teaching Kit for Smoking Education. However, it should be presented in the same manner as activity "c" above.

CONCEPTS	RESOURCES
41. Cells tend to be spherical, but they are usually jammed together and flattened. 42. Most cells are small; the relationship between the nucleus and the cytoplasm seems to limit their growth. 43. Large organisms do not as rule have larger cells than do small organisms; large organisms simply have more cells than do small ones.	41, 42, 43 The Molecule and the Biosphere, pp. 111-12
44. Cytology is a study of the cell. 45. The cytologist employs various methods and tools in his study of the cell. 46. An electron microscope forms an image with electrons instead of with light waves.	44, 45, 46 The Molecule and the Biosphere, pp. 113-18

ACTIVITIES

41, 42, 43

a. Use activities suggested in the text and teacher's guide to develop these concepts (especially the soap bubble and balloon demonstrations).

b. Use prepared slides (Explano-Mount or others) and/or 2" x 2" slides of muscle, bone, and nerve cells. Have the students identify the various parts of a cell in each case and note the similarities as well as the wide differences in structure of the different kinds of cells.

c. Several Micro-Slide Strips on topics that would relate to these concepts are available in each school to use in the Micro-Slide Viewers (10/school).

d. The following chart might be placed on the board to indicate comparative sizes of several objects:

CELLS	APPROXIMATE DIAMETER		
	Millimicrons	Microns	Millimeters
Ostrich egg	80,000,000	80,000	80
Cells from fruit	1,000,000	1,000	1
Amoeba	100,000	100	.1
Liver Cell	20,000	20	.02
Cell from Onion Root	17,000	17	.017
Red Blood Cell	7,500	7.5	.0075
Bacteria (Prodigiosus)	700	0.7	.0007
Typhus Fever Organism	500	0.5	.0005

44, 45, 46

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Pictures of cells taken with various kinds of microscopes may be obtained from Scientific American magazine or other sources and shown to the class.

c. Perhaps a student has a parent who is a cytologist, biologist, or biochemist and could talk to the class or provide materials about the study of cells.

CONCEPTS	RESOURCES
CHAPTER 5	
47. The world of living things consists largely of microorganisms. 48. A one-celled organism is not necessarily simple in structure and function; it may have achieved a high level of organization. 49. Some one-celled organisms exhibit little internal specialization; others are highly specialized. 50. Microorganisms can easily be cultured and observed.	47, 48, 49, 50 The Molecule and the Biosphere, pp. 123-30 A Sourcebook for the Biological Sciences, See Index for Protozoa and other topic FILMS Protozoa: Structures and Life Functions, Col, 16 min. Fresh Water Pond, Col., 13 min. Life in a Pond, Col., 11 min. Microscopic Life: World of the Invisible B./W., 14 min. World of Little Things, Col., 15 min. Life in a Drop of Water, Col., 11 min. Amoeba, B./W., 10 min. Microscopic Wonders in Water, Col., 10 min. Tiny Water Animals, B./W., 10 min. Life Story of the Paramecium, Col., 11 min. FILMSTRIPS Fs 576 Antony Van Leeuwenhoek (51 Fr.) Fs 593 One-Celled Animals (52 Fr.) Fs 593 World of One-Celled Animals (41 Fr.)
51. Many lower forms of life are many-celled; all higher forms of life are many-celled. 52. The cells of higher forms of life are grouped into three levels of structure and function: (1) epithelial, (2) organs, and (3) systems.	51, 52 The Molecule and the Biosphere, pp. 131-3 FILM Hydra, B./W., 10 min.
53. There are five basic kinds of tissues in the higher organisms: (1) epithelial, (2) muscle, (3) connective, (4) nerve, and (5) blood. 54. Some of the five main kinds of tissues are further divided into subtypes.	53, 54 The Molecule and the Biosphere, pp. 133-39

47, 48, 49 50

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Start Investigation 5, p. 122, in text, as an introduction to this chapter.

c. The major emphasis for this group of concepts and through this chapter should be a generalized student observation of a wide variety of microorganisms. These may then be compared to the depth study of the paramecium and amoeba.

d. Point out the use of phase-contrast and interference microscopes in the film, "Protozoa: Structures and Life Functions."

e. The film "Tiny Water Animals" shows the life processes of both the amoeba and paramecia.

51, 52

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Samples of multicelled invertebrates from the ocean or canyons may be brought in by students and studied as time permits. (Large snails could probably be found in any bed of iceplant.)

53, 54

a. Use activities suggested in the test and teacher's edition to develop these concepts.

b. Use the following charts available in each school:
   Animal Cell Types
   Hydra and Obelia
   Paramecium
   Amoeba and Euglena

c. Explano-Mount prepared slides, 2" x 2" slides, and micro-slide viewer strips showing different kinds of tissues are available in each school.

CONCEPTS

55. Tobacco, when used by man, has specific harmful effects on the respiratory system, the digestive system, the blood, and reproduction.

RESOURCES

55

"Teaching Kit for Smoking Education" Exhibit

Lung tissue sections, plastic mounted, shows emphysema; should be in each school by September, 1967.

FILMS
Healthy Lungs, B./W., 10 min.
Mechanisms of Breathing, 2nd Ed., B./W., 11 min.
Huffless, Puffless Dragon, Col., 8 min.
Is Smoking Worth It? Col., 16 min.
No Smoking, B./W., 11 min.
One in 20,000, Col., 30 min.
Time Pulls the Trigger, Col., 25 min.
From One Cell, Col., 12 min.
Smoking and Lung Cancer (available from Smoking Research/San Diego, phone 297-1643)

SOUNDSTRIP
Ss 613.81 To Smoke or Not To Smoke (in each school)

Transparent Overlay:

The Beleaguered Lung: Cancer Invedes (Class sets; of 40/school, more available through:
The American Cancer Society
San Diego County Branch
1405 Fifth Avenue
San Diego, Calif. 92101
Phone 234-8481

Content Suggestions ("Teaching Kit for Smoking Education")

The Respiratory System:

(1) Smoking causes paralysis of the cilia, the mechanism by which the respiratory system is cleansed of foreign materials.

(2) Smoking causes an increase in mucous secretions.

(3) Smoking causes irritation to the mouth, nose, throat, traches, and bronchi.

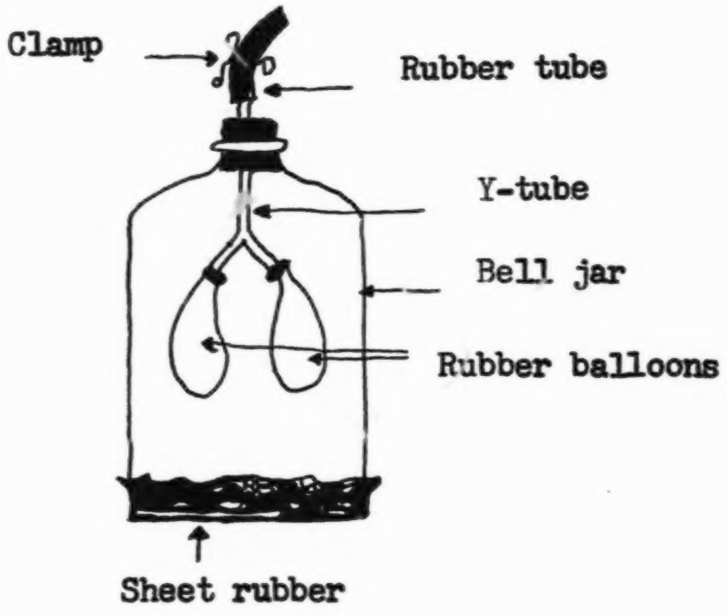
55

a. Refer to background materials in the Teaching Kit for Smoking Education. films. and the micro-slide viewer strip "Smoking and Health" to develop the content suggestions in the resources column.

b. Demonstrate the action of the lungs and the effects of emphysema as follows:

Purpose: To demonstrate the action of the lungs.

Equipment: Glass bell jar with 1-hole rubber stopper
Stopper
Sheet rubber to cover bottom of bell jar and act as diaphragm
2 balloons of same size
Glass Y-tube
Rubber tubing and pinch clamp



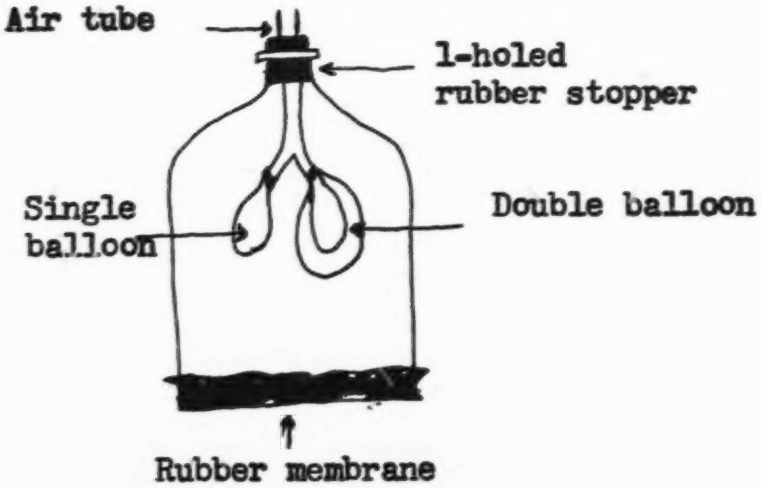
Procedure: Set up the aparatus as shown. The balloons simulate the lungs; the bell jar, the trunk of the body; and the sheet rubber, the diaphragm. Pull down on the sheet rubber to inflate the balloons, push down to deflate.

CONCEPTS	RESOURCES
55. (Cont.)	(4) Smoking causes breathlessness.
	(5) Smoking causes a chronic smoker's cough.
	(6) Smoking causes changes in the lung capacity.
	The Alimentary Tract
	(1) Smoking causes varying effects on stomach contractions.
	(2) Some people tend to eat more and to gain weight when they stop smoking.
	(3) Smoking dulls the senses of taste and smell.
	Blood
	Carbon monoxide in the bloodstream caused from inhaling tobacco smoke causes a decreased oxygenation in the red blood cells.
	Reproduction
	(1) Women who smoke during pregnancy tend to have babies of lower birth weight than women who do not smoke during pregnancy.
	(2) Women who smoke during pregnancy also tend to have more premature deliveries. Some of the products of tobacco smoke are evidently transferred from the vascular system of the mother through the placenta into the fetal circulation, thereby forcing the baby to "take a smoke."

ACTIVITIES

Purpose: To demonstrate the effects of emphysema on the action of the lungs.

Equipment: The same apparatus as used for the demonstration above with three balloons of the same size.



Procedure: Blow up one balloon and allow it to remain inflated for a day. Before proceeding with the demonstration, deflate the balloon, noting that it does not return to its original size, but remains stretched. Insert a new balloon into the used one, attach the double balloon to one angle of the Y-tube, and the second new balloon on the other angle of the Y-tube. Attach the sheet rubber; inflate and deflate the balloons.

Note the action of the "normal lung" and that of the double balloon "lung," where the air pocket interferes with inflation and deflation, just as with emphysema.

c. Discuss the various ways scientists have gone about finding the association or causal relation between certain diseases and cigarette smoking. Examples: animal experiments, statistical studies, autopsy evidence, and clinical observation.

CONCEPTS	RESOURCES
55. (Cont.)	Disease Conditions and Smoking There is evidence to support the belief that an association exists between smoking and certain diseases. In some cases there seems to be a causal relationship, and in other cases only an association has been shown; that is, certain diseases are more common in smokers than in non-smokers. (1) Cancer: of the lungs, the oral structures, the larynx, the esophagus, and the urinary bladder. (2) Respiratory diseases that are non-neoplastic: pulmonary emphysema and chronic bronchitis. (3) Cardiovascular diseases: coronary artery disease and some forms of peripheral vascular disease. (4) Other conditions: peptic ulcers, tobacco amblyopia, cirrhosis of the liver, and low birth weight.

d. Discuss some of the reasons for the changes in consumption of numbers of cigarettes and cigars and pounds of tobacco from 1900 to the present.

Suggested Topics For Student Investigations and Research Projects

Students may wish to choose one of the following topics for more detailed study and investigation.

- Information on pure food laws regarding handling, preparation, adulteration, and sale of foods.
- The significance of the "A" or "B" sign which is displayed at public eating places.
- Scurvy, rickets, pellagra, beriberi, and other deficiency diseases.

Teacher's Evaluation*

A Guide for Teaching General Science 1-2 (8th)

UNIT II

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

5. Which work sheet should be deleted or changed?

6. What additional work sheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

*Please fill out this form after the unit is completed. Completed forms should be sent to the Science Specialist, Room 2041, Education Center, at the end of each semester during the school year 1967-68.

UNIT III

BIOCHEMISTRY

UNIT III

BIOCHEMISTRY
(3 Weeks)

Goals of the Unit

During his study of this unit the student increases his understanding of the interdisiplinary nature of science by investigating some principles of elementary chemistry and applying these principles to an understanding of the digestive processes. Some concepts first introduced in Unit II, Chapter 2 (for example, "mixtures" and "solutions") are explained in depth for the student. The study of water, a basic solvent, draws the student into a deeper investigation of the atom and electron structure. The student's study of the digestion of foods gives him an opportunity to investigate nutrition as an extension of basic concepts.

Teaching Suggestions

This unit follows the basic text, The Molecule and the Biosphere, Chapters 9, 10, and 11. A variety of audio-visual aids, supplementary materials, and suggested student activities are coordinated with the "Concepts to be Developed" on the following pages.

It is recommended that the teacher evaluate his students' understanding of nutrition at the beginning of this unit. They have probably studied nutrients in their elementary courses in science and health and in junior high courses in home economics and physical education.

Books Referred to in This Unit

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the Physical Sciences. New York: Harcourt, Brace and World, Inc., 1961.

Lapp, Ralph E., and the Editors of Life. Matter. New York: Time Incorporated, 1965.

Morholt, Evelyn, et. al. Teaching High School Science: A Sourcebook for the Biological Sciences. New York: Harcourt, Brace and World, Inc., 1958.

Navarra, John G., et. al. Today's Basic Science: The Molecule and the Biosphere. New York: Harper and Row, 1965.

Concepts to be Developed

CHAPTER 9

1. A solution is a mixture composed of individual molecules and atoms.

2. A solution consists of two parts: a solvent and solute.

3. Water is an important solvent used for many purposes.

4. An element tends to be chemically active if its outermost shell is not filled with electrons.

5. Water is a polar compound; the water molecule carries an electric charge.

6. There are five general types of solutions: solid into liquid, gas into liquid, gas into gas, liquid into liquid, and solid into solid.

7. The solubility of a substance is the specific amount that dissolves in a given volume of a solvent.

8. A greater amount of the solute is likely to dissolve in a hot solvent than in a cold solvent.

9. Pressure increases the solubility of gases.

10. A saturated solution contains all the solute it is capable of holding.

11. A dilute solution contains a small amount of solute; a concentrated solution contains a large amount of solute.

CHAPTER 10

12. A colloid is a dispersion of tiny particles usually larger than molecules.

13. Colloidal particles cannot ordinarily be filtered from the dispersing medium.

14. There are eight kinds of colloidal suspensions: liquid in gas, solid in gas, gas in liquid, liquid in liquid, solid in liquid, gas in solid, liquid in solid, and solid in solid.

15. Man's body is a mass of organized colloids.

16. A membrane is a thin layer of tissue that serves as a covering.

17. Solutions can diffuse, or scatter, through membranes; colloids do not readily diffuse through membranes.

18. Osmosis is the diffusion of a fluid through a membrane into another fluid.

19. Absorption is the taking in of a substance by another substance.

20. Adsorption is the clinging of one substance to the surface of another substance.

CHAPTER 11

21. Digestion is the chemical change of foods into particles that can be absorbed by the body cells.

22. Such foods as water and vitamins require no digestion; they diffuse directly into the bloodstream.

23. Fats, proteins, and carbohydrates are broken down through the digestive process; they are broken down into molecules that can diffuse through the intestinal walls.

24. Hydrolysis is the breaking down of a compound by combining it with water.

25. An enzyme is a catalyst that speeds the hydrolysis of foods.

26. Glands produce digestive juices containing enzymes.

27. The alimentary canal consists of five main parts: the mouth, esophagus, stomach, small intestine, large intestine.

28. Digestion occurs in the mouth, in the stomach, and in the small intestine.

Resources and Activities
See pages 78-87.

CONCEPTS	RESOURCES
UNIT INTRODUCTION	Introduction The Molecule and the Biosphere,pp. 206-10 FILM Biochemistry: A General View, Lesson 79, B./W., 30 min.
CHAPTER 9	
1. A solution is a mixture composed of individual molecules and atoms.	1, 2
2. A solution consists of two parts: a solvent and solute.	The Molecule and the Biosphere, pp. 211-12 Matter, pp. 73, 84-85 A Sourcebook for the Physical Sciences, pp. 16-61 FILMSTRIP Fs 541.34 Some Things Dissolve, (40 fr.)
3. Water is an important solvent used for many purposes.	3, 4, 5, 6
4. An element tends to be chemically active if its outermost shell is not filled with electrons.	The Molecule and the Biosphere, pp. 213-2 Matter, pp. 74-75
5. Water is a polar compound; the water molecule carries an electric charge.	CER KIT (in each school) Solid State Physics
6. There are five general types of solutions: solid into liquid, gas into liquid, gas into gas, liquid into liquid, and solid into solid.	FILMS Chemistry of Water, Col., 14 min. Structure of Water, Col., 14 min. Water, Its Structure: Polar Molecules, Lesson 36, B./W., 30 min. Water, Some of Its Properties, Lesson 37, B./W., 30 min. Water, Its Peculiar Properties: Table Salt; Its Structure, Lesson 38, B./W., 30 min.

Introduction

a. Refer to teacher's edition, pp. 146-48.
b. Review the ways of organizing the various disciplines of science, (see Unit II, Introduction) and develop the meaning of "biochemistry."
c. Develop a bulletin board showing current examples of work in biochemistry.
d. Discuss the human body as a "living machine" and as a "living laboratory."

1, 2

a. Use activities suggested in the text and teacher's edition to develop these concepts.
b. Show and discuss the common household solutions illustrated on pp. 84-85 of Matter (Life Science Library).
c. Demonstrate the ease with which some solutions may be formed by setting up the ammonia fountain, pp. 160-61 in A Sourcebook for the Physical Sciences.
d. Use an overhead projector to show the formation of a solution:

Place a petri dish containing some water on the overhead projector. In the center of the dish place a tiny crystal of potassium permanganate. Have the pupils watch the action for a few minutes. Gently swirl the dish, and again have the pupils observe the crystal. Ask for a possible explanation of the action.

3, 4, 5, 6

a. Use activities suggested in the text and teacher's edition to develop these concepts.
b. Make models of water molecules using the Molecular Model Kit or styrofoam balls. Have students make models of water molecules using two different colors of modeling clay.
c. Make Thermo-Fax transparency for the overhead projector and/or Thermo-Fax copies for the class of the chart "From Atoms to Molecules," found in the CER kit "Solid State Physics." This chart shows the formation of water molecules.
d. Expand class understanding of water as a polar molecule by discussing the diagram showing the forces between water molecules on p. 75 of Matter.
e. Illustrate the effect of temperature on water volume as follows:

This investigation calls for a freezing mixture of cracked ice and salt. The ice should be cracked quite fine. This may be done by putting ice cubes into a cloth bag and pounding the bag with the broad side of an ax or a hammer. Prepare a quart bottle with a cork, a thermometer, and a bent glass tube (Fig. 1). Fill the bottle to the very top with water from the faucet as cold as can be drawn. Then press the stopper in firmly so that the water will flow into the tube nearly to the end. Place the bottle in a metal pail and pack ice and salt all around it.

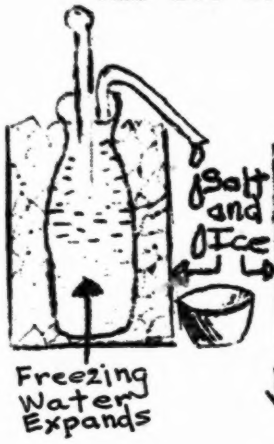


Fig. 1

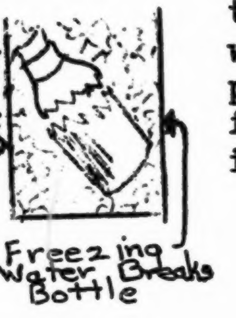


Fig. 2

CONCEPTS	RESOURCES
	3,4,5,6 (Cont.)
7. The solubility of a substance is the specific amount that dissolves in a given volume of a solvent. 8. A greater amount of the solute is likely to dissolve in a hot solvent than in a cold solvent. 9. Pressure increases the solubility of gases. 10. A saturated solution contains all the solute it is capable of holding. 11. A dilute solution contains a small amount of solute; a concentrated solution contains a large amount of solute.	7, 8, 9, 10, 11 The Molecule and the Biosphere, pp. 220-31 A Sourcebook for the Physical Sciences, pp. 154-85 A Sourcebook for the Biological Sciences, pp. 403-4 FILMS Liquids in Solution, Col, 11 min. Dynamics of Solution, Col. 15 min. Solutions, Col, 16 min.

Use a bowl or small dipper to handle the ice. Put in two dippers of ice first, and then scatter a dipper of salt over the ice. This makes the mixture two of ice to one of salt, as it should be for good freezing results. Continue adding two quantities of ice and one of salt, packing it well, until the freezing mixture reaches to the neck of the bottle. Watch the temperature go down and the water draw back through the tube, for the water contracts as it cools. But, suddenly, the water in the tube will come to a stop and then begin to flow into the tube again. The water in the bottle is getting colder and colder, but now it is expanding. The water will drip out of the tube until that in the bottle is frozen solid. However, the bottle may burst before the water does freeze solid.

It is an interesting modification of this investigation to fill a small screw-top bottle completely full of water, pack it in a freezing mixture (Fig. 2), and wait for the bottle to burst.

7, 8, 9, 10, 11

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to Chapter 8, "Solutions," pp. 154-85 in A Sourcebook for the Physical Sciences for a variety of activities illustrating various properties of water and solutions.

c. Refer to p. 404 in A Sourcebook for the Biological Sciences for "Table 21-1, General Solubility Rules." Methods of preparing solutions are also explained on pp. 403-4.

d. Illustrate saturated and unsaturated solutions as follows:

On the stage of the overhead projector set two petri dishes, one containing some water, the other an equal volume of a saturated sodium thiosulfate (hypo) solution. Drop a single hypo crystal into each dish. After the action has been observed for a few minutes, drop another hypo crystal in each dish. Stir each solution. Ask the pupils to explain why the crystal disappears in one dish and not in the other.

If an overhead projector is not available, use larger quantities of liquids in 250-ml. beakers.

e. Illustrate superaturation as follows:

Place two petri dishes, each containing one crystal of hypo on the overhead projector. Into one dish pour a saturated hypo solution; into the other dish pour supersaturated hypo solution. The latter solution will form excess crystals upon being poured into the dish. The seed crystal present in the dish makes the excess solute immediately leave the supersaturated solution which then becomes saturated. Relate the demonstration to the way in which unsaturated, saturated, and supersaturated solutions can be identified.

For best results, prepare the supersaturated solution just before class time and store the solution in the container in which it was prepared until using it.

If an overhead projector is not available, use larger quantities of reagents and larger beakers.

CONCEPTS	RESOURCES
CHAPTER 10	
12. A colloid is a dispersion of tiny particles usually larger than molecules.	12, 13, 14, 15
13. Colloidal particles cannot ordinarily be filtered from the dispersing medium.	The Molecule and the Biosphere, pp. 236-4 A Sourcebook for the Physical Sciences, pp. 162-63
14. There are eight kinds of colloidal suspensions: liquid in gas, solid in gas, gas in liquid, liquid in liquid, solid in liquid, gas in solid, liquid in solid, and solid in solid.	FILMS Colloids, Lesson 155, Col, 30 min.
15. Man's body is a mass of organized colloids.	

f. The effect of surface area on rate of dissolving may be illustrated as follows: Obtain a large crystal and an equal weight of tiny crystals of potassium dichromate or copper sulfate. Place two petri dishes containing equal volumes of water on the overhead projector. Into one dish, drop the large crystal; into the other dish, the small crystals. Observe the action in each dish for several minutes. Compare the color of the solution in the dishes. Ask the pupils for a possible explanation of the results. Usually they will suggest that more water comes in contact with the small crystals than with the large crystal.

g. The effect of temperature on the solubility of gases may be illustrated as follows: Place a bottle of soda water in ice water, chill, and open. Allow a second bottle to remain open at room temperature during the period. At the end of the period pour the contents of both into two glasses. Compare the amount of foam and the temperature of both solutions. The amount of foam is a rough approximation of the amount of gas that was dissolved in each solution.

h. The effect of pressure on the solubility of gases may be illustrated as follows: Display two bottles of soda water that have been standing at room temperature for a period of time. Take the cap off one bottle. Ask the pupils to explain why gas escapes from the solution in the open bottle and why there are no bubbles of gas seen in the liquid in the capped bottle.

12, 13, 14, 15

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to Section 82e, "Colloids," pp. 162-63 in A Sourcebook for the Physical Sciences. Several activities illustrating properties of colloids are given.

c. Refer to pp. 73-74, 84, 87 in Matter for background information and pictures of colloial phenomena.

CONCEPTS	RESOURCES
16. A membrane is a thin layer of tissue that serves as a covering. 17. Solutions can diffuse, or scatter, through membranes; colloids do not readily diffuse through membranes. 18. Osmosis is the diffusion of a fluid through a membrane into another fluid. 19. Absorption is the taking in of a substance by another substance. 20. Adsorption is the clinging of one substance to the surface of another substance.	16, 17, 18, 19, 20 The Molecule and the Biosphere, pp. 240-44 A Sourcebook for the Biological Sciences, pp. 32-35, 52-53 FILMS Osmosis, B./W., 14 min.
CHAPTER 11	
21. Digestion is the chemical change of foods into particles that can be absorbed by the body cells. 22. Such foods as water and vitamins require no digestion; they diffuse directly into the bloodstream. 23. Fats, proteins, and carbohydrates are broken down through the digestive process; they are broken down into molecules that can diffuse through the intestinal walls. 24. Hydrolysis is the breaking down of a compound by combining it with water. 25. An enzyme is a catalyst that speeds the hydrolysis of foods. 26. Glands produce digestive juices containing enzymes.	21, 22, 23, 24, 25, 26 The Molecule and the Biosphere, pp. 247-55 A Sourcebook for the Biological Sciences, pp. 58-65 FILMS Digestive Chemical, Part II, Col, 18 min. or Digestion of Foods, B./W., 11 min. Human Body: Digestive System, Col, 14 min. Exploring Your Growth, Col, 11 min. Carbohydrates and Fats, Lesson 80, B. /W., 30 min. Proteins, Enzymes, Lesson 81, B./W., 20 min. Chemical Reactions in the Animal Body, Lesson 83, B./W., 30 min. FILMSTRIP Fs Box 612.3 Food in the Body, Parts A & B (2 Fs, Manual)

ACTIVITIES

16, 17, 18, 19, 20

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Note: Care should be taken that students not confuse osmosis and diffusion. Osmosis is a special case of diffusion, where pure water passes through a membrane permeable only to the water. (See footnote, p. 34, in A Sourcebook for the Biological Sciences.) The text is not entirely clear on this point.

c. Refer to pp. 32-35 and 52-53 in A Sourcebook for the Biological Sciences. A variety of activity suggestions are given as illustrations of diffusion and osmosis. (Save preparation of collodion bags for next chapter.)

d. Fill an ordinary pharmaceutical gelatin capsule with molasses and place in a beaker of water. Observe 30-45 minutes later for results illustrating osmosis.

21, 22, 23, 24, 25, 26

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to pp. 58-65 in A Sourcebook for the Biological Sciences for background on text-suggested activities and additional activities.

c. Make sure students realize that the experiment in the text, p. 255, is a hydrolysis reaction.

CONCEPTS	RESOURCES
27. The alimentary canal consists of five main parts: the mouth, esophagus, stomach, small intestine, large intestine. 28. Digestion occurs in the mouth, in the stomach, and in the small intestine.	27, 28 The Molecule and the Biosphere, pp. 256-65 FILMS Digestion. Mechanical, Part I, Col, 15 min. Alimentary Tract, B./W., 12 min. Digestion In Our Bodies, Col, 11 min. FILMSTRIPS Fs 612.3 Human Digestive System, (39 fr.) Fs 612.3 Your Digestive System, (25 fr.) STUDY PRINT SP-0 612.3 Digestive Tract.

ACTIVITIES

27, 28

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Use the model of the human torso to observe the position, size, and structure of the digestive system.

c. Make Thermo-Fax copies of the student work sheet, "Digestive System," and have students make a label for their notebooks. (See Appendix p. 277.)

Teacher's Evaluation*

A Guide for Teaching General Science 1-2 (8th)

UNIT III

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

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2. List any titles which should be added to the audio-visual list.

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3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

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4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

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5. Which work sheet should be deleted or changed?

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6. What additional work sheets should be added to this unit? Please describe or submit draft.

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7. Other suggestions.

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*Please fill out this form after the unit is completed. Completed forms should be sent to the Science Specialist, Room 2041, Education Center, at the end of each semester during the school year 1967-68.

UNIT IV

BIOPHYSICS OF SOUND

UNIT IV

BIOPHYSICS OF SOUND
(2 Weeks)

Goals of the Unit

During his study of this unit, the student investigates interrelationships between biology and the physical sciences. The student compares "musical" and "noise" sounds and studies the ways these sounds move, are produced, and are heard. After completing this unit the student should have a deeper understanding and appreciation of acoustics, the study of sound.

Teaching Suggestions

This unit follows the basic text, The Molecule and the Biosphere, Chapters 12, 13, and 14. A variety of audio-visual aids, supplementary materials, and suggested student activities are coordinated with the "Concepts to be Developed" section below and on the following pages.

It is suggested that the teacher choose the activities to be done in class very carefully, and/or assign different activities to different teams with subsequent reports to the class, in order that the concepts can all be developed in the recommended time allotment of two weeks. Concepts marked with an asterisk(*) might be omitted in order to cover the other concepts in more detail.

Books Referred to in This Unit

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the Physical Sciences. New York: Harcourt, Brace, and World, Inc., 1961.

Navarra, John G., et. al. Today's Basic Science: The Molecule and the Biosphere. New York: Harper and Row, 1965.

Concepts to be Developed

CHAPTER 12

1. There are two definitions of sound: a physiological definition and a physical definition.
2. The physiological definition of sound requires: a vibration, a medium through which the vibration moves, and a receiving instrument which picks up the vibration.
3. According to the physical definition, sound is a disturbance in matter.
4. A vibration is a disturbance in matter; it is a movement within air, wood, steel, or some other medium.
5. Elasticity and momentum give rise to vibration.
6. A vibration produces sound.
7. Among the properties of a vibrating object are its frequency and amplitude.

8. A sound can have a high pitch or a low pitch; pitch is a psychological interpretation.

9. A vibrating object can cause another object to vibrate.

10. The pushing of molecules with air or some other medium gives rise to a sound wave.

11. A sound wave is an orderly sequence of compressed molecules and rarefied molecules; compression and rarefaction set up sound waves.

12. In a transverse wave, the particles of the medium vibrate at right angles to the wave itself.

13. A longitudinal wave moves in the same direction at which particles within the medium are vibrating.

14. A sound wave is a longitudinal wave.

CHAPTER 13

15. Elasticity and momentum can set a string to vibrating.

16. A string produces a sound wave when it vibrates.

17. One kind of wave is known as a standing wave; a node and an antinode are two important parts of a standing wave.

18. A stretched string produces a tone known as a fundamental when it vibrates as a whole.

19. A string can vibrate as a whole and in segments simultaneously, producing a blend of tones.

20. A parcel of air has elasticity.

21. Elasticity and momentum can set a column of air to vibrating.

22. A wave within an air column consists of a loop, a node, and an antinode.

23. A vibrating column of air produces a sound wave.

24. A percussion instrument produces a sound when it is struck; among the percussion instruments are drums, bells, and cymbals.

25. A percussion instrument produces irregular sound waves.

26. A set of vibrating strings (the vocal cords) produces the sound of your voice.

27. The vocal cords consist of two fibrous bands stretched across the voice box, or larynx.

28. The voice box is partly like a wind instrument and partly like a string instrument; the vocal cords vibrate like strings; a column of air within the voice box vibrates along with the vocal cords.

29. The vocal organs consist of the larynx, lungs, windpipe, throat, nose, and mouth.

30. The tone of one voice differs from the tone of another voice.

* 31. Animals have voice boxes and are able to make sounds.

* 32. The sounds of animals differ among the various species.

33. A sound classified as noise results from an irregular vibration.

34. There is no definite border line between tone and noise.

CHAPTER 14

35. The ear is a sense organ.

36. The function of the ear is to change sound energy into nerve impulses.

37. The chief parts of the ear are the outer ear, the middle ear, and the inner ear.

* 38. There are two types of deafness: (1) conduction deafness and (2) nerve deafness.

* 39. Conduction deafness is caused by an impairment of any part of the ear which conducts sound waves.

* 40. Nerve deafness is caused by damage to the nerves branching into the cochlea.

* 41. Hearing ability can be measured with an instrument called an audiometer.

* 42. Sound energy is measured in units known as decibels.

* 43. Sound waves can be directed around defective parts of the ear by means of hearing aids.

Resources and Activities
See pages 96-105.

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* Concepts not quoted from the basic text teacher's guide.

BIOPHYSICS OF SOUND

CONCEPTS	RESOURCES
UNIT INTRODUCTION	**Introduction** The Molecule and the Biosphere, pp. 275-77 FILMS Communication in the Modern World, Col, 11 min. Communication: Story of Its Development, Col, 11 min. Development of Communications, 2nd Ed., B./W., 11 min. FILMSTRIP Fs 534 Communication (32 fr., manual)
CHAPTER 12	
1. There are two definitions of sound: a physiological definition and a physical definition. 2. The physiological definition of sound requires: a vibration, a medium through which the vibration moves, and a receiving instrument which picks up the vibration. 3. According to the physical definition, sound is a disturbance in matter.	1, 2, 3 The Molecule and the Biosphere, pp. 277-79
4. A vibration is a disturbance in matter; it is a movement within air, wood, steel, or some other medium. 5. Elasticity and momentum give rise to vibration. 6. A vibration produces sound. 7. Among the properties of a vibrating object are its frequency and amplitude. 8. A sound can have a high pitch or a low pitch; pitch is a psychological interpretation.	4, 5, 6, 7, 8 The Molecule and the Biosphere, pp. 280-84 A Sourcebook for the Physical Sciences, pp. 426-46 FILMS Vibrations, Col, 13 min. Sounds All About Us, B./W., 11 min. Sounds Around Us, Col, 11 min. RECORD (also Tape) Rec 534 Science of Sound (Manual) I thru A

Introduction

a. Refer to teacher's edition, pp. 192-93.

b. Show one of the suggested films.

c. Bulletin board material that includes pictures of musical instruments, cameras, radio or television receiving sets, and the ear, will be of general interest.

1, 2, 3

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Stress the fact that philosophic and/or semantic considerations lead to the necessity for the two different definitions of sound given in the text.

4, 5, 6, 7, 8

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to Chapter 19, "Sound and Music," pp. 426-46, in A Sourcebook for the Physical Sciences for background and additional activities.

CONCEPTS	RESOURCES
9. A vibrating object can cause another object to vibrate. 10. The pushing of molecules with air or some other medium gives rise to a sound wave. 11. A sound wave is an orderly sequence of compressed molecules and rarefied molecules; compression and rarefaction set up sound waves.	9, 10, 11 The Molecule and the Biosphere, pp. 285-87 A Sourcebook for the Physical Sciences, pp. 426-46 FILMS Nature of Sound, B./W., 11 min. FILMSTRIP Fs 534.2 How Sound Travels (39 Fr.)
12. In a transverse wave, the particles of the medium vibrate at right angles to the wave itself. 13. A longitudinal wave moves in the same direction at which particles within the medium are vibrating. 14. A sound wave is a longitudinal wave.	12, 13, 14 The Molecule and the Biosphere, pp. 288-92 FILMS Fundamentals of Acoustics (Rev.) B./W., 11 min. Sound Waves, B./W., 15 min. Sound Waves and Their Sources (Rev.), B./W., 10 min. Waves and Energy, Col, 11 min.

9, 10, 11

a. Use activities suggested in the text and teacher's edition to develop these concepts.
b. Refer to Chapter 19, "Sound and Music," pp. 426-46 in A Sourcebook for the Physical Sciences for background and additional activities.
c. Have students work problems involving the relationship between wavelength frequency, and velocity. Use for the speed of sound in air: 330 m/sec. or 1100 ft/sec. Use the following chart for velocities. Have students refer to pp. 341-43 in the text.

The speed of sound at 20° (approx.)

For example: (1) Find the frequency of a sound of wavelength 1.0 cm. (2) What is the wavelength of the sound waves of C two octaves above middle C if their frequency is 1044 vibrations/sec.

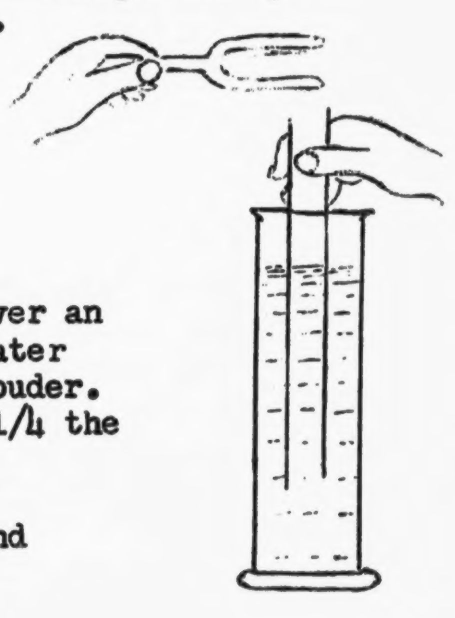
Aluminum = 16,750 ft/sec
Copper = 11,670
Iron = 16,820
Water = 8,800 - 1,435 m/sec
Alcohol = 3,890

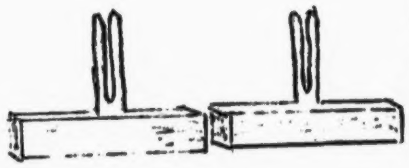
12, 13, 14

a. Use activities suggested in the text and teacher's edition to develop these concepts.
b. Refer to Chapter 19, "Sound and Music," pp. 426-46 in A Sourcebook for the Physical Sciences for background and additional activities.
c. Set up the audio oscillator and oscilloscope (available from Instructional Aids Distribution Center; see equipment list at front of this guide). Sound waves may be shown on the screen, and the differences in wavelength and amplitude demonstrated. A microphone, amplifier, loudspeaker, tape recorder, etc. may be used to demonstrate various sound phenomena.

   Suggestion: Check with an electronics teacher to arrange for needed equipment and help in making the proper connections.
d. Discuss the following phenomena in terms of constructive and destructive interference. Draw diagrams on the board and use the oscilloscope set up in "c" above to illustrate the overlap of the sound waves.

Resonance. Set up the tuning fork and resonance boxes opposite each other. Strike one and make it vibrate. Touch the prongs and stop the vibration. Put a heavy rubber band around a prong of one of the forks to slow the vibration. Strike both tuning forks at once and observe the "beats" formed.





Resonance. Hold a vibrating tuning fork over an air column or one-liter graduate. Pour water into the graduate until the fork sounds louder. The length of the resonant air column is 1/4 the wavelength of the sound.

A suggested student work sheet to accompany this activity is found in the Appendix, p. 281.

CONCEPTS	RESOURCES
CHAPTER 13	
15. Elasticity and momentum can set a string to vibrating. 16. A string produces a sound wave when it vibrates. 17. One kind of wave is known as a standing wave; a node and an antinode are two important parts of a standing wave. 18. A stretched string produces a tone known as a fundamental when it vibrates as a whole. 19. A string can vibrate as a whole and in segments simultaneously, producing a blend of tones. 20. A parcel of air has elasticity. 21. Elasticity and momentum can set a column of air to vibrating. 22. A wave within an air column consists of a loop, a node, and an antinode. 23. A vibrating column of air produces a sound wave. 24. A percussion instrument produces a sound when it is struck; among the percussion instruments are drums, bells, and cymbals. 25. A percussion instrument produces irregular sound waves.	15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25 The Molecule and the Biosphere, pp. 297-306 A Sourcebook for the Physical Sciences, pp. 426-46 FILMS Musical Notes, B./W., 12 min. Sounds of Music, B./W., 10 min. Science of Musical Sounds, Col, 11 min.
26. A set of vibrating strings (the vocal cords) produces the sound of your voice. 27. The vocal cords consist of two fibrous bands stretched across the voice box, or larynx.	26, 27, 28, 29, 30 The Molecule and the Biosphere, pp. 307-10 A Sourcebook for the Physical Sciences, pp. 442-43

15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to Chapter 19, "Sound and Music," pp. 426-46 in A Sourcebook for the Physical Sciences for background and additional material.

c. Use the oscilloscope-microphone-amplifier-loudspeaker setup referred to in 12, 13, and 14-c, above to illustrate the sounds produced by various types of musical instruments brought in by the students.

d. Use the demonstration organ pipe available in each school to show the effects of varying the length of an air column.

26, 27, 28, 29, 30

a. Use activities from the text and teacher's edition to develop these concepts.

b. Have one or more students make a model of human vocal cords as shown on pp. 442-43 in A Sourcebook for the Physical Sciences.

CONCEPTS	RESOURCES
28. The voice box is partly like a wind instrument and partly like a string instrument; the vocal cords vibrate like strings; a column of air within the voice box vibrates along with the vocal cords. 29. The vocal organs consist of the larynx, lungs, windpipe, throat, nose, and mouth. 30. The tone of one voice differs from the tone of another voice.	26, 27, 28, 29, 30 (Cont.) FILMS Speech Chain, Col, 19 min. FILMSTRIP Fs Box 534 Speaking and Hearing (2 Fs, Manual) STUDY PRINT SP-0 612.78 Throat - Larynx with Pharynx RECORD "He Saw the Kaht," Bell Telephone Laboratory (in each school)
31. Animals have voice boxes and are able to make sounds. 32. The sounds of animals differ among the various species. 33. A sound classified as noise results from an irregular vibration. 34. There is no definite border line between tone and noise.	31, 32, 33, 34 The Molecule and the Biosphere, pp. 310-11 FILM Sounds in the Sea, Col, 16 min. SOUNDSTRIP (also in each school) Underwater Acoustics, (29 Fr) 10 min. (from SS551.46 CER Oceanography Series, I thru A) RECORDS Rec 534 Sound Patterns (Manual) Rec 534 Strange to Your Ears
CHAPTER 14	
35. The ear is a sense organ. 36. The function of the ear is to change sound energy into nerve impulses. 37. The chief parts of the ear are the outer ear, the middle ear, and the inner ear.	35, 36, 37 The Molecule and the Biosphere, pp. 317-29 FILMS Ears and Hearing, B./W. 11 min. How the Ear Functions, B./W. 11 min. Your Ears, B./W. 10 min.

31, 32, 33, 34

Use activities suggested in the text and teacher's edition to develop these concepts.

35, 36, 37

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Use filmstrip "Speaking and Hearing" if not used previously for concepts 26, 27, 28, 29, and 30.

c. Use model of the ear to point out the various structures, (available in each school).

d. Use the diagram of the ear, Appendix p. 279.

CONCEPTS	RESOURCES
	FILMSTRIPS Fs Box 534 Speaking and Hearing (2 Fs, Manual) Fs 612.85 You and Your Ears (51 Fr.) Fs 612.85 Your Ears and Hearing (25 Fr.) STUDY PRINTS SP-L 612.85 How We Hear, Sectional Diagram of the Human Ear SP-O 612.85 Ear SP-L 612.85 Sectional Diagram of the Human Ear
38. There are two types of deafness: (1) conduction deafness and (2) nerve deafness 39. Conduction deafness is caused by an impairment of any part of the ear which conducts sound waves. 40. Nerve deafness is caused by damage to the nerves branching into the cochlea. 41. Hearing ability can be measured with an instrument called an audiometer. 42. Sound energy is measured in units known as decibels. 43. Sound waves can be directed around defective parts of the ear by means of hearing aids.	38, 39, 40, 41, 42, 43 The Molecule and the Biosphere, pp. 330-33

38, 39, 40, 41, 42, 43

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Discuss the range of human hearing. Test the class with the audio oscillator, amplifier, and loudspeaker set up previously.

c. Discuss how some animals make use of ultrasonic sounds. Use the ultrasonic dog whistle to demonstrate. Discuss the principles of sonar.

Suggested Topics For Student Investigation and Research Projects

Students may wish to choose one of the following topics for more detailed study and investigation.

- The uses of hypersonics and ultrsonics.
- Sonar and radar.
- The research on sound being conducted at the Naval Electronics Laboratory.
- Various hearing defects and hearing aids.

Teacher's Evaluation *

A Guide for Teaching General Science 1-2 (8th)

UNIT IV

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

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2. List any titles which should be added to the audio-visual list.

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3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

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4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

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5. Which work sheet should be deleted or changed?

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6. What additional work sheets should be added to this unit? Please describe or submit draft.

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7. Other suggestions.

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*Please fill out this form after the unit is completed. Completed forms should be sent to the Science Specialist, Room 2041, Education Center, at the end of each semester during the school year 1967-68.

UNIT V

ASTRONOMY AND LIFE IN SPACE

UNIT V

ASTRONOMY AND LIFE IN SPACE
(5 Weeks)

Goals of the Unit

During the study of this unit, the student explores the technology and biological aspects of space and travel and space exploration. He also explores a variety of basic concepts in astronomy. The student gains an understanding and appreciation of the relationship of the earth to other members of our solar system and to the universe, and of the effects of astronomical phenomena upon our existence and habits on the earth. The student also gains knowledge of how man learns about conditions in the universe, and a realization of the practical values of a knowledge of astronomy to the individual. The authors of the basic texts stress for the student the many interdisciplinary aspects of these topics, and also stress the meaning and importance of the process of interaction between individuals and between inanimate objects.

Teaching Suggestions

This unit draws material from the basic text, The Molecule and the Biosphere, Chapters 17 and 18; the basic text, The Atom and the Earth, Chapter 1; the supplementary text, Ramsey and Burckley, Modern Earth Science, 1965, Chapters 1, 2, 3, 4, and 5; and the supplementary texts, University of Illinois, Elementary School Science Project, Astronomy Series, 1966, Numbers 1, 2, 3, 4, 5, and 6. The supplementary texts listed above are coordinated with the basic texts to provide greater depth of study in astronomy than is provided in the basic texts. A variety of audio-visual aids, other supplementary materials, and suggested student activities are also coordinated with the "Concepts to be Developed" section on the following pages.

Many more resources than can possibly be used are listed several places in this unit, especially under Concepts 11, 12, 13, and 14. It is recommended that the teacher choose supplementary materials carefully in order not to get bogged down in the wealth of factual material available. A thorough understanding of the basic concepts in these areas prepares the student to study specific areas in detail in future courses and probably confuses him less than a mass of factual information would.

It is recommended that the teacher be especially alert to new developments in the areas covered in this unit, Many newspaper and magazine articles, etc. may be used to enrich the text presentation and keep it up-to-date.

If available, the UNESCO Sourcebook for Science Teaching, United Nations, 1962 (also printed as 700 Science Experiments for Everyone) has 30 good activities related to this unit in its Chapter VI, "Experiments and Materials for Astronomy."

Refer also to the current edition of NASA Aerospace Bibliography, Washington, D. C.: United States Government Printing Office.

Books Referred to in This Unit

Elementary School Science Project. Astronomy Series. Urbana, Illinois: University of Illinois, 1966.
Charting the Universe, 1
The Universe in Motion, 2
Gravitation, 3
The Message of Starlight, 4
The Life Story of a Star, 5
Galaxies and the Universe, 6

Heller, Robert L. Geology and Earth Sciences Sourcebook for Elementary and Secondary Schools. New York: Holt, Rinehart and Winston, Inc., 1962.

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the Physical Sciences. New York: Harcourt, Brace, and World, Inc., 1961.

MacCracken, Helen D., et. al. Basic Earth Science. State Textbook, 1967.

MacCracken, Helen D., et. al. Basic Life Science. State Textbook, 1967.

MacCracken, Helen D., et. al. Basic Physical Science. State Textbook, 1967.

Navarra, John G., et. al. Today's Basic Science: The Atom and the Earth. New York: Harper and Row, 1965.

Navarra, John G., et. al. Today's Basic Science: The Molecule and the Biosphere. New York: Harper and Row, 1965.

Ploutz, Paul F., et. al. Laboratory Manual: Basic Earth Science. Syracuse, New York: L. W. Singer Company, 1964.

Ramsey, William L. and Burckley, Raymond A. Modern Earth Science. New York: Holt, Rinehart and Winston, Inc., 1961.

Space Primer. San Diego, California: General Dynamics/Convair, 1959.

Zim, Herbert S. and Baker, Robert H. Stars. New York: Simon and Schuster, 1956.

Concepts to be Developed

1. Ptolemy believed that the sun and the planets revolved around the earth.
2. Copernicus established the accepted belief that the earth revolves around the sun.
3. Interactions among astronomers have helped us to understand the solar system.
4. Interaction is a give-and-take experience between two persons or between a person and the conditions of his environment.
5. The face-and-point method is a system for locating stars and planets.
6. Gravitation is a force of attraction possessed by all materials in the universe.
7. Gravitational force decreases rapidly with distance.

8. The more material in an object, the greater its gravitational pull.

9. Motion, gravitation, gyroscopic stability, nuclear energy, radiations, and magnetism all help to organize the universe.

10. The earth, spinning as a gyroscope, has one end of its axis pointed toward the region near Polaris, the North Star.

11. An observer interacts with the stars and planets when he studies the night-time sky.

12. The stars and planets are in motion; the sky changes from month to month.

13. All heavenly bodies of the solar system follow the same laws of science.

14. The universe is composed of coutless stars, much like our own, organized into galaxies that are much alike.

15. Distances beyond the solar system are measured in light-years instead of in miles.

16. Space is not empty: it contains radiation, atomic particles, and magnetic fields.

17. Radiation is constantly streaming through space.

18. A band of particles known as the magnetosphere surrounds the earth.

19. An earthlike environment is necessary for the survival of man in space.

20. Weightlessness is one of the major problems of space exploration.

21. Biologists are exploring the possibility of extraterrestrial life.

22. A knowledge of physics and biochemistry has been applied to the development of life-detection instruments.

23. Man must establish a closed ecological system to survive in space.

24. A balanced aquarium is a closed ecological system.

25. Scientists hope to develop a self-sustaining system for the protection and support of men in space.

26. A life-support system must supply the basic needs of men: water, food, and oxygen.

Resources and Activities
See pages 114-129.

CONCEPTS	RESOURCES
UNIT INTRODUCTION	Introduction *The Atom and the Earth*, pp. 8-11 *The Molecule and the Biosphere*, pp. 397-400 FILMS How Many Stars? Col, 11 min. Earth, Our Planet, B./W., 20 min. Story of Palomar, Col, 40 min. FILMSTRIPS Fs 520.9 Astronomy Through the Ages (51 Fr.) Fs 523 Man Studies the Stars (31 Fr.)

ACTIVITIES

Introduction

a. Refer to teacher's editions, as follows:
   The Atom and the Earth, pp. 1-5
   The Molecule and the Biosphere, pp. 272-275

b. Most students already have some knowledge of, and interest in, astronomy. Any of several approaches to the unit in the eighth grade might be used effectively. A good display of pictures and articles from magazines could serve as a basis for discussion of a variety of topics to be studied. Pictures of Palomar Observatory are particularly valuable in this region. Pupils should be asked to bring in material and to be on the alert for pictures and articles to be used by the class. Each school library has sets of pictures, "Moon Exploration," which stimulate interest in space travel.

c. Pupils who have visited Palomar Observatory, Mt. Wilson, Griffith Planetarium, Winslow Meteor Crater, and other space and astronomy centers could be asked to tell the class of their visits and impressions.

d. Questions on current topics should certainly be used to encourage interest and observations: What planets can be seen in the sky now? Which planet is "the evening star"? Have you ever seen a comet in San Diego? Has it ever been possible to see an eclipse of the sun or moon in San Diego?

e. A list of words to be used in the study of astronomy might be put on the chalkboard. Have the pupils tell quickly what idea comes to their minds as you read these words: sun, comet, Orion, star, Mars, standard time, telescope, planet, fireball, Big Dipper, satellite, constellation, meteor, planetoid, North Star, Venus, equinox, astronomy, astrology, and so on.

f. Show one or more of the general interest films and/or filmstrips suggested at the left.

CONCEPTS	RESOURCES
CHAPTER 1, The Atom and the Earth 1. Ptolemy believed that the sun and the planets revolved around the earth. 2. Copernicus established the accepted belief that the earth revolves around the sun. 3. Interactions among astronomers have helped us to understand the solar system.	1, 2, 3 The Atom and the Earth, pp. 13-16 Basic Earth Science, pp. 260-74 A Sourcebook for the Physical Sciences, pp. 81-103 Stars, pp. 16-30 Modern Earth Science, pp. 2-6 FILMS Charting the Universe: with Optical and Radio Telescopes, Col, 13 min. How We Explore Space, Col, 16 min. Universe, B./W., 28 min. Understanding Our Universe, Col, 11 min. FILMSTRIPS Fs 520.9 Astronomy Through the Ages Fs 522.2 Eyes and Ears Fs 523 Man Studies the Stars Fs 523 Time, Space, and Energy Fs 522.1 Galileo Fs 522.2 Mount Wilson and Palomar Telescopes SLIDES 2x2 522.2 Palomar Telescope TRANSPARENCIES Trns 523 Astronomy

ACTIVITIES

1, 2, 3

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Students should be able to differentiate between refracting and reflecting telescopes. Labeled diagrams could be required in their notebooks. Students should illustrate the path of incoming light from space to show understanding of how telescopes operate. Refer to pp. 34-35 in the student text The Atom and the Earth.

c. Demonstrate how a double convex lens can be used to gather light and concentrate it at one point. Face the lens toward the window and hold a piece of paper behind it to show the image formed. Use the slide projector or other light source if sunlight is not available.

d. If an enlarging mirror is available, show how a concave mirror gathers light and concentrates it. A concave microscope mirror can be used.

e. A "Questar" telescope is available from the Instructional Aids Distribution Center (Equipment List, p. 12 of this guide) to give a "live" demonstration of one type of telescope.

f. Point out the forms of energy by which we are able to interact with the stars. The wall charts, "Electromagnetic Radiations" and "Spectrum," available in most schools, add depth to this section.

g. Demonstrate the use of a prism to produce the full spectrum of sunlight. Use a slide projector or other light source if sunlight is not available.

h. Ways in which astronomers interpret the forms of energy referred to in "f" above may be illustrated as follows:

-Flame Tests for Metallic Ions in Salts: Flame tests depend upon the fact that light emitted from each metallic ion has a characteristic color. The traditional way of doing the flame test has been to heat a platinum wire, touch it to some salt (or solution), and then hold it in the flame of a burner. This method is time-consuming because it necessitates cleaning the wire between each test so that the wire will give no color when it is heated in the flame. The method described below eliminates this. In addition, the flame will give more color. Take a thin sheet of aluminum about 2½ inches long by 1½ inches wide. Bend this into a trough. Then clamp it on the ring stand about 1 inch above the top of the burner. Take a piece of glass tubing 4 to 5 inches long and attach an atomizer bulb to it. Place a small amount of the first powdered salt to be tested in the trough. Adjust the burner to give a colorless flame. Blow the salt into the flame by directing a blast of air from the atomizer bulb along the trough. Have students record the color of the flame. The chart can be placed on the chalkboard. Brush out the trough. Test each of the other salts listed in the table below, brushing out the trough between samples.

CONCEPTS	RESOURCES
	1,2,3, (Cont.)

ACTIVITIES

-An Alternative Method of Performing Tests: A saturated solution of a soluble salt is placed in a polyethylene plastic spray bottle. These plastic bottles serve as an excellent means of storing soluble metallic salts. When the salt is sprayed into the air hole of a Bunsen burner, a color characteristic of the metallic ion will be seen in the flame.

The colors seen in the flame tests are the strongest colors that are given off by any particular substance. If the light which is produced by the heating is analyzed by means of a spectroscope, the separate lines of color can be seen and photographed.

Each element can be identified by a series of colored lines (a bright line spectrum) characteristic of that element alone. Spectrum analysis is extremely sensitive and is a very useful tool for the analytical chemist as well as the astronomer.

FLAME TESTS

COMPOUNDS TESTED	COLOR OF FLAME
Sodium Compounds	Yellow
Lithium Compounds	Crimson
Strontium Compounds	Red-Scarlet
Calcium Compounds	Orange-Yellow
Barium Compounds	Yellow-Green
Copper Chloride	Blue-Green
Potassium Compounds	Violet

CONCEPTS	RESOURCES
4. Interaction is a give-and-take experience between two persons or between a person and the conditions of his enviornment. 5. The face-and-point method is a system for locating stars and planets. 6. Gravitation is a force of attraction possessed by all materials in the universe. 7. Gravitational Force decreases rapidly with distance. 8. The more material in an object, the greater its gravitational pull. 9. Motion, gravitation, gyroscopic stability, nuclear energy, radiations, and magnetism all help to organize the universe. 10. The earth, spinning as a gyroscope, has one end of its axis pointed toward the region near Polaris, the North Star.	4, 5, 6, 7, 8, 9, 10 The Atom and the Earth, pp. 19-26 Basic Earth Science, pp. 263-64, 277-83, 346-68 Basic Physical Science, pp. 20-47, 208-09 Geology and Earth Sciences Sourcebook, pp. 234-40 Basic Life Science, pp. 252-63 FILMS Gravity, B./W., 10 min. Shape of the Earth, Col, 29 min. How We Know the Earth's Shape, Col, 11 min. Balancing Forces, Col, 14 min. Force of Gravity, Copy B, Col, 29 min. Gravity, How It Affects Us, Col, 14 min. How We Know the Earth Moves, Col, 11 min. Gravity, Weight, and Weightlessness, Col, 11 min. FILMSTRIPS Fs 530.1 Gravity Fs 538.7 Earth's Magnetism

ACTIVITIES

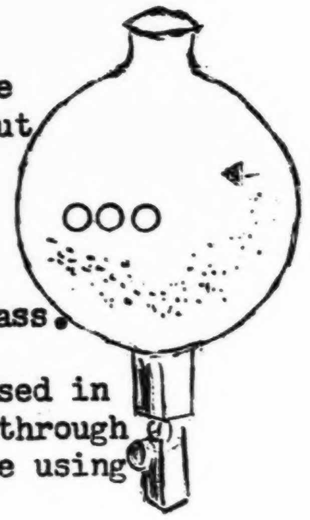
4, 5, 6, 7, 8, 9, 10

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to the Laboratory Manual; Basic Earth Sciences, for the following activities:

Lab 22, Indirect Measurement, pp. 57-59, 107
Lab 23, Measuring Latitude by Polaris, pp. 60-62, 109
Lab 24, Earth's Magnetic Field, pp. 63-64, 111
Lab 25, Gyroscope Stability, pp. 65-66

c. To demonstrate the relationship of mass to centrifugal force and centripetal force, place three balls of the same size but different densities into a globe and rotate it so that the balls are halfway up the side of the globe. This would be about 200-300 r.p.m. The height to which the balls will rise up the slope of the globe is dependent upon angular velocity and the radius of the globe and is independent of mass. The three balls will take up positions at the same heights dependent upon the speed of the rotation. Care should be used in placing the balls in the globe; they should not be dropped through the opening at the top. A similar demonstration can be done using mercury and colored water.



d. Use the centrifugal hoop on the hand rotator as follows: The centrifugal hoop, when rotated on a horizontal or vertical axis, flattens out. This is because the metal at the equator of the hoop tends to keep in its same instantaneous straight-line direction and thus pulls away from the center, and in order to get farther away, flattens the entire hoop. This action demonstrates the reason for the flattening of the earth at the poles.

e. Magnetic lines of force can be demonstrated by placing a bar magnet on a table. Place a large sheet of paper over the magnet. Sprinkle fine iron filings on the paper from a height of about one foot. Tap the paper gently. Show the results. This demonstration may be done on an overhead projector with an elevated piece of acetate or thin glass instead of the paper.

CONCEPTS	RESOURCES
11. An observer interacts with the stars and planets when he studies the nighttime sky. 12. The stars and planets are in motion; the sky changes from month to month. 13. All heavenly bodies of the solar system follow the same laws of science. 14. The universe is composed of countless stars, much like our own, organized into galaxies that are much alike.	11, 12, 13, 14 The Atom and the Earth, pp. 27-29 Basic Earth Science, pp. 285-317, 400-10 Basic Physical Science, pp. 240-41, 278-84 Modern Earth Science, pp. 6-58 Geology and Earth Sciences Sourcebook, pp. 229-34, 236-40 Stars, pp. 31-135 FILMS Flaming Sky, Col, 29 min. Solar Family, B./W., 13 min. Nearest Star, Col, 29 min. Our Star, Col, 11 min. Portrait of the Sun, Col, 19 min, Sun, B./W., 11 min. Our Mr. Sun, Part I, Col, 30 min. Our Mr. Sun, Part II, Col, 30 min. Planets in Orbit, (Laws of Kepler), B./W., 10 min. Sun's Family, B./W., 10 min. Jupiter, Saturn, and Mars in Motion, Col, 8 min. Asteroids, Comets, and Meteorites, Col, 11 min. Space Science: The Planets, Col, 16 min. Space Science: Comets, Meteors, and Planetoids, Col, 11 min. Mars and Beyond, Col, 30 min. New Frontiers in Space, B./W., 24 min. Milky Way, B./W., 11 min. Constellations: Guides to the Night Sky, Col, 11 min. Stars and Star Systems, B./W., 16 min. Depths of Space, B./W., 11 min. FILMSTRIPS Fs 523.2 Introduction to the Solar System Fs 523.2 Neighbors in Space Fs 523.2 Neighbors in Space, Copy B Fs 523.4 Giant Planets: Jupiter, Saturn, Uranus, and Neptune Fs 523.4 Mars Fs 523.4 Mercury and Venus Fs Box 523.4 Our Neighbors in Space, Parts A & B Fs 523.4 Planets and Comets Fs 523.44 Between the Planets

11, 12, 13, 14

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to the Laboratory Manual; Basic Earth Science, for the following activity: Lab 29, Orbits of Planets and Satellites, pp. 74-76, 113-14.

c. Some of the information concerning the various planets should be updated from NASA publications. Mariner and Ranger data should be of help in this respect.

d. Some discrepencies in data have been detected. Temperatures of various parts of the sun are expressed differently in different sources. NASA data should be used to update this material. Some of these discrepencies may be corrected in the state-published version.

e. Sections of the "Supplemental Exercises for Gifted and Talented Students" may be used to advantage to provide for individual differences.

f. Give the students an opportunity to work with a star finder such as the "Astrorama."

g. The Doppler effect in the light of stars is presented by simple diagram and description, p. 240 in Geology and Earth Sciences Sourcebook. Explain that the change in wavelengths due to going toward and away from a star is similar to the wavelength change in sound as evidenced in the sound of an approaching and receding train whistle.

h. Have each pupil draw a series of sky maps showing the position of the Big Dipper, Little Dipper, and Cassiopeia for 9:00 p.m., 11:00 p.m., 1:00 a.m., and 3:00 a.m. Have the students decide whether the position of these constellations could be used as a clock.

i. Constellations models can be made using a Tinker Toy set.

j. Use a star chart to locate various constellations and stars. (Star charts should be at every school. Consult your department chairman.)

k. Have students volunteer to make up window models of different constellations, using black construction paper and holes punched out for the stars in the constellation. Have these students properly label each constellation and sketch the outline of the figure it represents. Reports may also accompany these illustrations, if desired, explaining legendary background of star constellations.

CONCEPTS	RESOURCES

11, 12, 13, 14 (Cont.)

FILMSTRIPS (Continued)

Fs 523.7	Exploring the Sun
Fs 523.7	Our Sun
Fs Box 523.7	Sun and Earth, Parts A & B
Fs 523.7	Sun's Awesome Impact
Fs 523.3	Moon
Fs 523.3	Moon, Copy B
Fs 523.3	Silvery Moon
Fs 523.8	Milky Way
Fs 523	Man Becomes an Astronomer
Fs 523.1	Galaxies
Fs 523.1	Man in the Universe
Fs 523.1	Milky Way and Other Galaxies
Fs 523.1	Milky Way Galaxy
Fs 523.1	Nebulae
Fs 523.1	Universe in Color
Fs 523.1	Universe and Space
Fs 523.1	The Universe
Fs 523.8	Abnormal Stars
Fs 523.8	How Far Are the Stars?
Fs 523.8	On the Sky
Fs 523.8	Why the Stars
Fs 523.89	Sky Patterns
Fs 523.8	More About the Stars

SLIDES

523 (2x2)	Planets and Stars

STUDYPRINTS

SP-S 523.3	Moon
SP-L 523.3	Through the Eyepiece: The Moo
SP-S 523.3	Through the Eyepiece: The Moo
SP-S 523.2	Solar System

11, 12, 13, 14 (Cont.)

l. Suggest students take time exposures of stars. They can vary exposure time from one to several hours. Experiment with various portions of the sky. Develop the film, make prints, and make up a notebook of these prints. Discuss why the star tracks are curved.

m. Have students describe (sketch and write up) the shape, form, and dimensions of the Milky Way. Locate our sun in the galaxy of the Milky Way.

n. Other sources of constellation charts or sky maps include: The Universe in Motion, pp. 21-26; Constellation Charts to Accompany Enrichment Astronomy Lessons, Walker, Wanda M., San Diego City Schools, 1961.

CONCEPTS	RESOURCES
CHAPTER 17, The Molecule and the Biosphere	15, 16, 17, 18
15. Distances beyond the solar system are measured in light years instead of miles. 16. Space is not empty; it contains radiation, atomic particles, and magnetic fields. 17. Radiation is constantly streaming through space. 18. A band of particles known as the magnetosphere surrounds the earth.	The Molecule and the Biosphere, pp. 400-04 Basic Life Science, pp. 306-07 FILMS What is Space? Col, 10 min. Van Allen Radiation Belts, Col, 17 min.
	19, 20, 21, 22
19. An earthlike environment is necessary for the survival of man in space. 20. Weightlessness is one of the major problems of space exploration. 21. Biologists are exploring the possibility of extraterrestrial life. 22. A knowledge of physics and biochemistry has been applied to the development of life-detection instruments.	The Molecule and the Biosphere, pp. 404-09 Basic Life Science, pp. 302-09 CER Kit (in each school) Space Science FILMSTRIP Fs 523.4 Life on Other Planets

15, 16, 17, 18

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Present current information about the "solar wind." Refer to Scientific American, Senior Science, or Science World for recent articles. (Check with school librarian.)

c. Refer to any information related to these concepts presented in films shown previously.

d. Use the charts "Electromagnetic Radiations" and "Spectrum" available in most schools.

19, 20, 21, 22

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Use the soundstrip "Medical Aspects of Space Flight" from the CER Kit "Space Science."

c. Refer to the Laboratory Manual; Basic Earth Science for the following activity: Lab 26, Extraterrestrial Life, pp. 67-69.

d. Refer to any information related to these concepts presented in films shown previously.

CONCEPTS	RESOURCES
CHAPTER 18, The Molecule and the Biosphere 23. Man must establish a closed ecological system to survive in space. 24. A balanced aquarium is a closed ecological system. 25. Scientists hope to develop a self-sustaining system for the protection and support of men in space. 26. A life-support system must supply the basic needs of men: water, food, and oxygen.	23, 24, 25, 26 The Molecule and the Biosphere, pp. 412-22 Basic Life Science, pp. 252-62, 285-302, 309-10 FILMS Simple Plants: The Algae, Col, 17 min. First Men into Space, B./W., 10 min.

23, 24, 25, 26

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. A variety of additional activities are suggested on the indicated pages in Basic Life Science.

c. If time permits, the teacher might want to refer back to Chapter 15, "Basic Elements of Ecology," in The Molecule and the Biosphere.

d. Refer particularly to the adverse physiological effects of alcohol, tobacco, and narcotics on persons preparing for or traveling in space.

Suggested Topics For Student Investigations and Research Projects

Students may wish to choose one of the following topics for more detailed study and investigation.

- Theories of the origin of the universe
- The stellar universe
- Supernova
- Dwarf star
- Cepheid variable

- Spiral nebula
- Supergalaxy
- Evolution of interstellar material
- "Electronic Photography of Stars" (Scientific American, March, 1956)
- "Clouds of Magellan" (Scientific American, April, 1956)

- "The Arms of the Galaxy" (Scientific American, December, 1959)
- "Life Outside the Solar System" (Scientific American, April, 1960)
- "Stellar Populations" (Scientific American, November, 1958)
- The significance of the zodiac and the twelve constellations in it
- Origin of the rings of Saturn

- Discovery of Neptune by Wilheim Herschel
- Discovery of Uranus by Leverrier and J. C. Adams
- Discovery of Pluto by Percival Lowell
- Meteor Crater at Winslow
- Siberian meteorite of 1908

- Ptolemaic and Copernican systems
- Meaning of the zodiac
- Canals of Mars
- Famous volcanoes and glaciers
- The Grand Canyon and its origin

- The geological history of San Diego
- The history of the San Diego River
- Project Mohole and San Diego's part in its activities
- IGY (International Geophysical Year)
- Soil conservation information about San Diego County from the local Department of Agriculture office.

- The Temple of Stonehenge
- Solstice and equinox
- Van Allen radiation belts
- Telescope making
- Moon landing sites
- Star maps

Teacher's Evaluation*

A Guide for Teaching General Science 1-2 (8th)

UNIT V

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

5. Which work sheet should be deleted or changed?

6. What additional work sheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

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*Please fill out this form after the unit is completed. Completed forms should be sent to the Science Specialist, Room 2041, Education Center, at the end of each semester during the school year 1967-68.

UNIT VI

ENERGY OF LIGHT

UNIT VI

ENERGY OF LIGHT
(2 Weeks)

Goals of the Unit

During his study of this unit, the student explores the properties of light energy and its place on the elctromagnetic spectrum. The presentation builds on the student's past experiences with light in the elementary grades, and leads him to investigate such concepts as the wave-particle duality of light. Interaction among scientists in developing our knowledge about light is stressed and helps the student develop an appreciation for the history of science.

Teaching Suggestions

This unit follows the basic text, The Atom and the Earth, Chapter 2. A variety of audio-visual aids, supplementary materials, and suggested student activities are coordinated with the "Concepts to be Developed" section below.

It is recommended that the basic text, Chapter 3, "Photosynthesis," be omitted because this material is covered in General Science 3 at Grade 9.

The use of a pretest over such basic concepts as reflection, opaque, transparent, and translucent would establish the level of prior learning of the class. The state-adopted unitext Light by Bertha M. Parker would help those students who lack prior background in light.

Books Referred to in This Unit

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the Physical Sciences. New York: Harcourt, Brace and World, Inc., 1961.

MacCracken, Helen D., et. al. Basic Physical Science. Chicago: L. W. Singer Company, 1964.

Navarra, John G., et. al. Today's Basic Science: The Atom and the Earth. New York: Harper and Row, 1965.

Concepts to be Developed

1. White light breaks apart into six spectrum colors: red, orange, yellow, green, blue, violet.
2. Light bends, or refracts, upon passing at an agle from one medium to another medium.
3. The speed of light is about 186,000 miles per second.
4. The velocity of light is constant; it is the highest speed that anything can attain.
5. The primary pigment colors are not the same as the primary light colors.

6. Newton's corpuscular theory suggests that light consists of particles.

7. Huygen's wave theory suggests that light moves in waves, not in particles.

8. A light wave is a transverse wave; a transverse wave vibrates at a right angle to the path in which it travels.

9. Polarized light consists only of waves vibrating in the same direction, or on the same plane.

10. Light can knock electrons off certain metals; this emission of electrons is known as the photoelectric effect.

3

Resources and Activities

CONCEPTS	RESOURCES
INTRODUCTION	Introduction The Atom and the Earth, pp. 39-42 FILM Demonstration with Light, Col, 14 min.
CHAPTER 2 1. White light breaks apart into six spectrum colors: red, orange, yellow, green, blue, violet. 2. Light bends, or refracts, upon passing at an angle from one medium to another medium. 3. The speed of light is about 186,000 miles per second. 4. The velocity of light is constant; it is the highest speed that anything can attain. 5. The primary pigment colors are not the same as the primary light colors.	1, 2, 3, 4 The Atom and the Earth, pp. 43-49 A Sourcebook for the Physical Sciences, pp. 447-92 FILMS Light: Illumination and Its Measurement Col, 14, min. Light: Refraction, Col, 14 min. Light: Lenses and Optical Instruments, Col, 14 min. Learning About Light, B & W, 8 min. Light and Its Story, Col, 14 min. Nature of Light, Col, 11 min. Refraction, B & W, 8 min. Light and Color, Col, 13 min. Nature of Color, Col, 10 min. FILMSTRIPS Fs 535.6 Light and Color (38 Fr.) Fs 535.6 What is Color? (50 Fr.)

ACTIVITIES

Introduction

a. Refer to teacher's edition, pp. 21-23.

b. Use a "pretest" over such concepts as reflection, mirrors, opaque, transparent, translucent, and color vision (covered in Unit I) to determine the level of prior learning of the class.

c. Show the film "Demonstration with Light" both as an amusing review of the unit on sound and an introduction to light and the photoelectric effect.

d. Illustrate the energy of light (its ability to do work) with the Crooks Radiometer (in each school).

e. Organize a bulletin board showing various examples of light phenomena; try to include the maser and laser.

f. Put up the large chart "Electromagnetic Spectrum" available in each school.

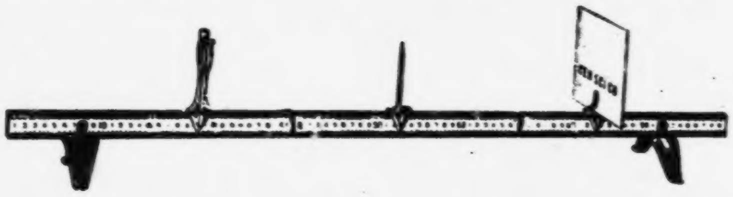
1, 2, 3, 4

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to Chapter 20, "Light and Color," pp. 447-92, in A Sourcebook for the Physical Sciences for background and additional activities.

c. Prisms, lenses, and materials for setting up optical benches are available in each school.

Set up a meter stick with len holders and screen. Measure the distance between the object and lens and the distance between image and lens. Refer to pp. 95-97 in the text for the mathematics of lenses.



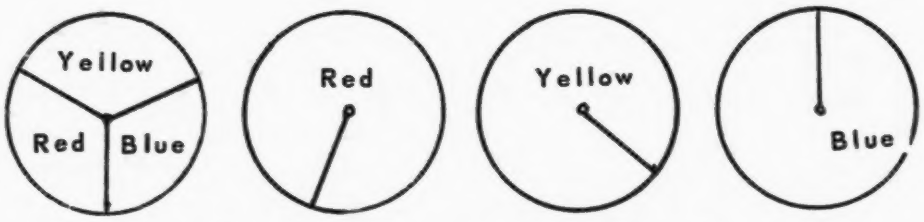
d. Compare light and sound as to velocity; how each is produced and transmitted. Compute the time necessary for the light from the sun to reach the earth.

e. Bring out the fact that the rays bend toward the perpendicular when going from a less dense medium to one that is more dense.

f. Use a piece of calcite to show double refraction.

CONCEPTS	RESOURCES
	1,2,3,4 (Cont.)
6. Newton's corpuscular theory suggests that light consists of particles. 7. Huygens' wave theory suggests that light moves in waves, not as particles.	6, 7 The Atom and the Earth, pp. 49-55 Basic Physical Science, pp. 242-66 FILM Light: Wave and Quantum Theories, Col, 14 min.
8. A light wave is a transverse wave; a transverse wave vibrates at a right angle to the path in which it travels. 9. Polarized light consists only of waves vibrating in the same direction, or on the same plane. 10. Light can knock electrons off certain metals; this emission of electrons is known as the photoelectric effect.	8, 9, 10 The Atom and the Earth, pp. 56-58, 92-

g. Use the hand-rotating apparatus (available in each school) to demonstrate the mixing or blending of colors. Also, make disks from red, yellow, and blue construction paper (see diagram) and experiment with different combinations and/or proportions of each color on the hand rotator.



Color Discs of About 6" Diameter

h. To show that the index of refraction depends on the kinds of media (Snell's Law), use a glass prism in air, in water, and in a sugar solution if the solution has the same index of refraction as the glass in the prism. (Experiment to find the proper concentration of sugar solution for a particular prism.)

6, 7

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to Chapter 20, "Light and Color," pp. 447-92, in A Sourcebook for the Physical Sciences for background and additional activities.

c. Set up a ripple tank to demonstrate wave phenomena.

d. A long spring for demonstrating longitudinal and transverse waves is available in each school.

e. Refer back to the principles of wave motion studied in the unit on sound.

f. Refer to pp. 242-66 in Basic Physical Science for a very clear presentation of electromagnetic radiation.

8, 9, 10

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to the film "Demonstrations with Light" for examples of the photoelectric effect. (Show as an introduction to this unit or show now.)

c. The text, pp. 92-94, and current materials from science magazines may be used to present ideas leading to an understanding of lasers.

Teacher's Evaluation*

A Guide for Teaching General Science 1-2 (8th)

UNIT VI

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

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2. List any titles which should be added to the audio-visual list.

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3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

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4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

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5. Which work sheet should be deleted or changed?

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6. What additional work sheets should be added to this unit? Please describe or submit draft.

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7. Other suggestions.

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*Please fill out this form after the unit is completed. Completed forms should be sent to the Science Specialist, Room 2041, Education Center, at the end of each semester during the school year 1967-68.

UNIT VII

Introductory Chemistry Concepts

UNIT VII

INTRODUCTORY CHEMISTRY CONCEPTS
(3 to 4 Weeks)

Goals of the Unit

During his study of this unit, the student pursues the historical development of our knowledge about the atom and examines in detail the structure of the atom. A study of the information presented in the Periodic Table of the Elements helps the student apply his knowledge of atomic structure to specific elements. Information about the elements is then utilized by the student in learning about molecules and compounds, the kinds of chemical bonds, and the basic types of inorganic and organic compounds.

Teaching Suggestions

This unit follows the basic text, The Atom and the Earth, Chapters 4, 5, and 6. A variety of audio-visual aids, supplementary materials, and suggested student activities are coordinated with the "Concepts to be Developed" section below and on the following pages.

Books Referred to in This Unit

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the the Physical Sciences. New York: Harcourt, Brace, and World, Inc., 1961.

Lapp, Ralph E., and the editors of Life. Matter. New York: Time Inc., 1965.

Navarra, John G., et. al. The Atom and the Earth. New York: Harper and Row, 1965.

Wilson, Mitchell, and the editors of Life. Energy. New York: Time Inc., 1963.

Concepts to be Developed

CHAPTER 4

1. All matter is made up of atoms.

2. Every atom has the same basic structure consisting of a nucleus and orbital electrons.

3. The atoms of different elements differ from one another in the number of protons and electrons they contain.

4. An atom is three-dimensional; it has depth and volume, like a ball.

5. A charged atom is known as an ion; an atom becomes a positive ion when it loses an electron; it becomes a negative ion when it gains an electron.

6. A flow of electrons gives rise to an electric current.

7. The electrons in an atom are arranged in energy levels and energy sublevels.

8. An electron gives off energy when it drops from a higher level to a lower energy level.

9. Scientists can identify materials by means of spectrum analysis.

10. Protons and neutrons are found within the nucleus of the atom.

11. Isotopes are different types of atoms of the same element.

12. An isotope of an element differs from other isotopes of the same element only in the number of neutrons it contains and in atomic weight.

CHAPTER 5

13. The Periodic Table of the Elements is an orderly arrangement of the 103 chemical elements known to scientists.

14. All the elements are arranged in groups and periods within the Periodic Table.

15. Elements belonging to the same group have similar properties.

16. The Periodic Table is made up of three short periods and four long periods.

17. The properties of an element are determined to a large extent by its electron configuration.

18. Similar properties among elements recur periodically; thus, the elements fall into groups withing the Periodic Table.

19. There are nine groups of elements; all groups of elements except Group VIII and Group 0 contain subgroups.

20. All the elements within a subgroup have similar properties.

21. Elements with few electrons in their outer shells are usually the most active.

22. An active element combines readily with other elements; it frequently is involved in chemical reactions.

23. Mendeleyev devised the Periodic Table of the Elements.

24. Moseley improved the Periodic Table by arranging the elements according to their atomic numbers.

25. Metals combine with nonmetals to form oxides, chlorides, and sulfides.

26. Metals tend to lose electrons when they combine with other elements; nonmentals tend to gain electrons when they combine.

27. In general, the inert gases are inactive, although they can enter into reactions under certain conditions.

28. A molecule is formed when two or more atoms are linked together.

29. A compound is a substance consisting of two or more elements chemically combined.

30. The smallest whole unit of a compound is a molecule.

31. A structural formula shows how the atoms of a molecule are linked together.

32. A chemical equation shows the results of a chemical reaction.

33. Valence is the combining power of an atom.

34. An electron-dot formula shows the number of valence electrons in the atom of an element.

35. Ionic bonding is the linking of ions; one ion loses an electron and the other gains an electron.

36. The ions of ionic compounds separate when the compound dissolves.

37. The full symbol for an ion shows its negative valence or positive valence.

38. The atoms involved in covalent bonding share electrons.

39. Inorganic chemistry is largely a study of ionic compounds; among the ionic compounds are acids, bases, and salts.

40. Organic chemistry is primarily a study of carbon compounds; covalent bonds hold carbon compounds together.

Resources and Activities

See pages 150-159.

CONCEPTS	RESOURCES
INTRODUCTION	Introduction The Atom and the Earth, pp. 98-101 FILMS Wonder of Chemistry (Rev.), B & W, 11 mi Preface to Chemistry, 16 min. Chemistry and a Changing World, 2nd Ed., B & W, 11 min. FILMSTRIPS Fs 540 Introduction to Chemistry (52 Fr Fs 540 What Is Chemistry? (32 Fr.)
CHAPTER 4 1. All matter is made up of atoms. 2. Every atom has the same basic structure consisting of a nucleus and orbital electrons. 3. The atoms of different elements differ from one another in the number of protons and electrons they contain. 4. An atom is three-dimensional; it has depth and volume, like a ball. 5. A charged atom is known as an ion; an atom becomes a positive ion when it loses an electron; it becomes a negative ion when it gains an electron.	1, 2, 3, 4, 5 The Atom and the Earth, pp. 103-08 Matter, Molecules, and Atoms, pp. 3-34 A Sourcebook for the Physical Sciences, pp. 104-07, 112-19 (Refer back to Unit II, Concepts 4-16, for applicable materials.) FILMSTRIP Fs 541.372 Ionization and Dissociation in Solution (49 Fr.) CER KIT (in each school) Solid State Physics
6. A flow of electrons gives rise to an electric current. 7. The electrons in an atom are arranged in energy levels and energy sublevels. 8. An electron gives off energy when it drops from a higher level to a lower energy level. 9. Scientists can identify materials by means of spectrum analysis	6, 7, 8, 9, 10, 11, 12 The Atom and the Earth, pp. 108-16 A Sourcebook for the Physical Sciences, pp. 112-19 CER KIT (in each school) Nuclear Energy FILMS Electrons at Work, Col, 14 min. Magnetic, Electric, and Gravitational Fields, Col, 11 min. Spectrograph, Col, 20 min.

Introduction

a. Refer to teacher's edtition, pp. 57-59.

b. A discussion covering such points as the following would provide good introductory material: How many of you have had a chemistry set? What is meant by synthetic? How is chemistry used around our homes? In transportation? In gardening? What kinds of professional people need to have a knowledge of chemistry?

c. Use an oral review or pretest to refresh the student's memory of concepts concerning matter and energy from Units II and III.

d. Bulletin board material on the chemical elements and advertisements of chemical companies that frequently appear in such magazines as *Life*, *Time*, and *Scientific American* are always of interest.

e. Show one or more of the suggested films to build interest.

1, 2, 3, 4, 5

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer back to activities used in Unit II, Chapter 2, *The Molecule and the Biosphere* (Unit II of this course). Review them with the class and/or use at this point those not done previously.

c. Refer students who need additional background or review to the Unitext booklet, Basic Science Education Series, *Matter, Molecules and Atoms*, pp. 3-34.

d. Use the chart "Atoms Large and Small" from the CER Kit, "Solid State Physics." A Thermo-Fax overhead projector transparency and/or Thermo-Fax ditto master for student copies may also be made. Rutherford's discovery of the nucleus is depicted in the chart "Inside the Atom" from the same kit.

e. Refer to *A Sourcebook for the Physical Sciences*, pp. 104-07, for background, and pp. 112-19 for additional ideas on making models of atoms and molecules.

6, 7, 8, 9, 10, 11, 12

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Showing the film "Magnetic, Electric, and Gravitational Fields" could be coordinated with the text experiment, p. 110, that illustrates electron arrangements.

c. Chalkboard diagrams and/or cardboard or other models (see *A Sourcebook for the Physical Sciences*, pp. 112-19) should help clarify electron shells, subshells and orbitals.

CONCEPTS	RESOURCES
10. Protons and neutons are found within the nucleus of the atom.	FILMSTRIP Fs 541.38 Discovering Isotopes (52 Fr.)
11. Isotopes are different types of atoms of the same element.	
12. An isotope of an element differs from other isotopes of the same element only in the number of neutrons it contains and in atomic weight.	
CHAPTER 5	13 through 24
13. The Periodic Table of the Elements is an orderly arrangement of the 103 chemical elements known to scientists.	The Atom and the Earth, pp. 125-37 A Sourcebook for the Physical Sciences, pp. 119, 121-22
14. All the elements are arranged in groups and periods within the Periodic Table.	FILMS Chemical Families, Col, 20 min. Family of Halogens, Col, 13 min.
15. Elements belonging to the same group have similar properties.	
16. The Periodic Table is made up of three short periods and four long periods.	
17. The properties of an element are determined to a large extent by its electron configuration.	
18. Similar properties among elements recur periodically; thus, the elements fall into groups within the Periodic Table.	
19. There are nine groups of elements; all groups of elements except Group VIII and Group 0 contain subgroups.	
20. All the elements within a subgroup have similar properties.	
21. Elements with few electrons in their outer shells are usually the most active.	

d. A chart showing the spectra of a variety of substances is available in each school.

e. A chart depicting the components of a helium atom is available in the CER Kit "Nuclear Energy."

13 through 24

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. The film "Family of Halogens" helps develop the general use of the Periodic Table.

c. Have the class teams do the Periodic Table investigation referred to in Unit II if not done then in connection with or in place of Investigation 5, p. 124, in the student text.

d. Approaches to studying the groups of elements are suggested on pp. 119 and 121-22 in A Sourcebook for the Physical Sciences.

e. Have students make two columns with the following headings: "Probably do exist" and "Probably do not exist." Place each formula in the proper column. Use the Periodic Table and knowledge of elements gaining or losing electrons to place them.

HCl BeO AlO $InAs$ $LiBr$ CCl_4 H_2O H_4I NO HeI HXe

CaO FrF $NeAr$ KNa CO_2 CaN GeO_2 AlS HF HS_2 $MgCl_2$

CONCEPTS	RESOURCES
22. An active element combines readily with other elements; it frequently is involved in chemical reactions.	
23. Mendeleyev devised the Periodic Table of the Elements.	
24. Moseley improved the Periodic Table by arranging the elements according to their atomic numbers.	
CHAPTER 6	25, 26, 27
25. Metals combine with nonmetals to form oxides, chlorides, and sulfides.	The Atom and the Earth, pp. 141-45
26. Metals tend to lose electrons when they combine with other elements; nonmetals tend to gain electrons when they combine.	FILM Metals and Nonmetals, Col, 11 min.
27. In general, the inert gases are inactive, although they can enter into reactions under certain conditions.	
28. A molecule is formed when two or more atoms are linked together.	28, 29, 30, 31, 32, 33, 34
29. A compound is a substance consisting of two or more elements chemically combined.	The Atom and the Earth, pp. 145-49
30. The smallest whole unit of a compound is a molecule.	FILMS Energy and Reaction, Col, 15 min. Determining Molecular Formulas, Col, 13 min.
31. A structural formula shows how the atoms of a molecule are linked together.	
32. A chemical equation shows the results of a chemical reaction.	

25, 26, 27

Use activities suggested in the text and teacher's edition to develop these concepts.

28, 29, 30, 31, 32, 33, 34

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. An example of a chemical change can be shown by igniting a 20-gram pile of ammonium dichromate on an asbestos pad.

c. Spontaneous combustion involving chemicals can be shown by placing a quantity of powdered potassium permanganate equal to the size of a navy bean and adding to it a drop of glycerin.

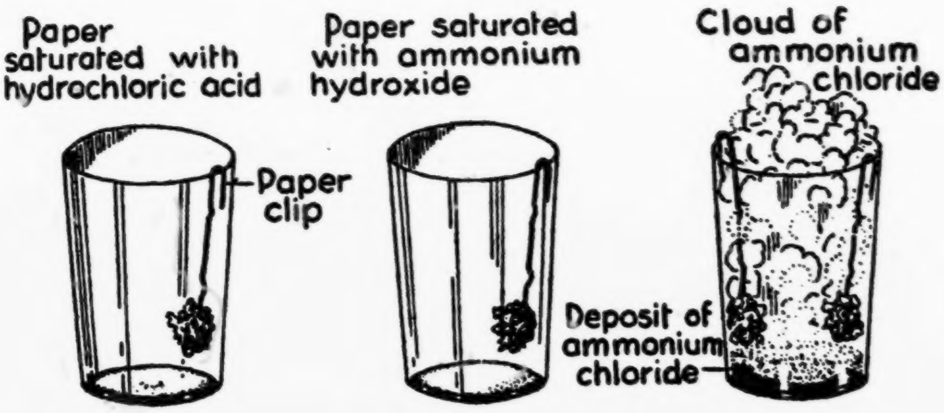
d. Decompose some mercuric oxide in a test tube. When the tube is very hot, test for oxygen with a glowing splint. The splint should burst into flame.

e. Place an iron spatula in a copper sulfate solution in a 600-ml beaker. The copper should be deposited on the spatula.

f. Discuss the charts of "Some Useful Compounds" and "Some Useful Elements" with the class, and/or make Thermo-Fax ditto master copies for the class. (See Appendix, pp. 283-4.)

CONCEPTS	RESOURCES
33. Valence is the combining power of an atom.	28, 29, 30, 31, 32, 33, 34 (Cont.)
34. An electron-dot formula shows the number of valence electrons in the atom of an element.	
35. Ionic bonding is the linking of ions; one ion loses an electron and the other gains an electron.	35, 36, 37, 38 The Atom and the Earth, pp. 150-54 FILMS Ionic and Covalent Binding Contrasted, Lesson 35, B & W, 30 min. Ionization, Col, 19 min.
36. The ions of ionic compounds separate when the compound dissolves.	
37. The full symbol for an ion shows its negative valence or positive valence.	
38. The atoms involved in covalent bonding share electrons.	
39. Inorganic chemistry is largely a study of ionic compounds; among the ionic compounds are acids, bases, and salts.	39, 40 The Atom and the Earth, pp. 154-162 A Sourcebook for the Physical Sciences, pp. 173-81, 267-97 FILM Acids, Bases and Salts, B & W, 21 min.
40. Organic chemistry is primarily a study of carbon compounds; covalent bonds hold carbon compounds together.	

g. The reaction of two gases to form a solid can be effectively demonstrated as shown in the diagram. Two small wads of paper towel or absorbent cotton are fastened on to bent wires or paper clips. One is dipped into some hydrochloric acid and suspended in a glass or beaker as shown. The other is dipped into ammonium hydroxide and suspended in another glass. Then the two are suspended in a third glass and the reaction is observed. A white cloud of ammonium chloride results and after a short time a visible deposit of the salt collects on the inside of the glass.


Paper saturated with hydrochloric acid
Paper clip
Paper saturated with ammonium hydroxide
Cloud of ammonium chloride
Deposit of ammonium chloride

35, 36, 37, 38

a. Use activities suggested in the text and teacher's edition to develop these concepts.

39, 40

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. A discussion of acids, bases, salts, neutralization, and indicators may be based on the material on pp. 173-81 of A Sourcebook for the Physical Sciences.

c. Background information on a wide variety of organic compounds and activities illustrating their properties are given on pp. 267-97 of A Sourcebook for the Physical Sciences.

d. Preparation of acids: Place a small amount of sulfur in a deflagrating spoon and ignite it with a Bunsen burner. Lower the spoon with the sulfur into a wide-mouthed bottle that has a little water in the bottom. After 30 seconds or so, remove the sulfur, cover the bottle, and shake. Drop a piece of blue litmus paper into the solution. Drop a red flower into the jar and leave for a few minutes. Sulfurous acid is a good bleaching agent. Carbon (charcoal) or a very small amount of red phosphorus can be substituted for the sulfur.

CONCEPTS	RESOURCES
	39, 40 (Cont.)

e. Preparation of a base: Add a small piece of CaO to some water in a beaker. Stir the mixture and test it with red litmus paper. Blot oil from bits of sodium or potassium the size of a pea. Throw on water. Be sure to have an area of about five feet cleared away from the container. Use forceps in handling these elements. Test the resulting solution for the presence of a base.

f. Use other indicators such as methyl orange, phenolphthalein, tea, red cabbage juice, and bromine blue to show their reaction to acids and bases.

g. Refer to Laboratory Manual; Basic Physical Science for the following activities:

Lab 10, Acids and Bases, pp. 23-25, 75-76
Lab 12, Chemistry and Clothing Fabrics, pp. 29-30, 77
Lab 13, Polymers, pp. 31-32
Lab 14, Hydrocarbon Molecules, pp. 33-34
Lab 15, Organic Chemistry: Soap and Water Hardness, pp. 35-37

Teacher's Evaluation*

A Guide for Teaching General Science 1-2 (8th)

UNIT VII

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any *demonstrations and/or* laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

EVALUATION SHEET

5. Which work sheet should be deleted or changed?

6. What additional work sheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

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*Please fill out this form after the unit is completed. Completed forms should be sent to the Science Specialist, Room 2041, Education Center, at the end of each semester during the school year 1967-68.

UNIT VIII

NUCLEAR ENERGY OF THE ATOM

UNIT VIII

NUCLEAR ENERGY OF THE ATOM
(2 Weeks)

Goals of the Unit

During his study of this unit, the student builds on his knowledge of the structure of the atom developed in the previous unit to understand the energy locked in the atomic nucleus. The contribution of nuclear energy to advances in industry, medicine, and research is explained to the student, thus stressing its importance as a natural resource. An understanding of radioactive decay, half-life, and the formation of new isotopes leads the student to a study of fission and fusion reactions and nuclear reactors. A brief overview of atomic particle accelerators ends the unit.

Teaching Suggestions

This unit follows the basic text, The Atom and the Earth, Chapters 7 and 8. A variety of audio-visual aids, supplementary materials, and suggested student activities are coordinated with the "Concepts to be Developed" section below and on the following pages.

It is recommended that the teacher be especially alert to new developments in the areas covered in this unit. Many newspaper and magazine articles may be used to enrich and keep the text presentation up to date.

The pamphlet, "Nuclear Terms-A Brief Glossary," would be particularly helpful in this unit. Free copies of this pamphlet and a variety of other materials are available from the United States Atomic Energy Commission, Division of Technical Information. Address: USAEC, P. O. Box 62, Oak Ridge, Tennessee 37830.

Books Referred to in This Unit

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the Physical Sciences. New York: Harcourt, Brace, and World, Inc., 1961.

Lapp, Ralph E., and the editors of Life. Matter. New York: Time Incorporated, 1965.

Navarra, John G., et. al. The Atom and the Earth. New York: Harper and Row, 1965.

Wilson, Mitchell, and the editors of Life. Energy. New York: Time Incorporated, 1963.

Concepts to be Developed

CHAPTER 7

1. X rays are a form of radiation; they are a part of the electro-magnetic spectrum.
2. The discovery of X rays led to a study of radioactivity.
3. Becquerel and the Curies (Marie and Pierre) shared in the discovery of radioactivity.
4. Radioactivity atoms give off alpha rays, gamma rays, and beta particles.

5. An isotope is a type of an element; and isotope of an element differs from another isotope of the same atom only in atomic weight, that is, in the number of neutrons it contains.

6. An atom decays and becomes a different type of atom when its nucleus emits an alpha ray or a beta particle; such an atom is radioactive.

7. Half-life is the time it takes for one half of any given quantity of a radioactive element to change into a new element.

8. The decay of one atom leads to the decay of other atoms in a radioactive series.

9. Nuclear physicists write balanced equations to show nuclear reactions.

CHAPTER 8

10. Nuclear fission is the splitting of an atom.

11. The splitting of an atom gives rise to a chain reaction.

12. Energy is released when an atom splits.

13. Nuclear fusion is the joining of one atomic nucleus with the nucleus of another atom.

14. Energy is released in the fusion of atoms.

15. A nuclear reactor is an "atomic furnace"; the nuclear reactor uses the energy of the atom to generate heat energy.

16. A nuclear reactor consists of six main parts; moderator, coolant, shielding, fuel rods, control rods, and heat exchanger.

17. Nuclear reactors are used to manufacture radioisotopes.

18. A particle accelerator accelerates atomic particles to tremendous velocities; these high-speed particles then strike the nuclei of target atoms, causing them to split.

19. An accelerator is a research tool; it enables physicists to observe the behavior of nuclear particles.

20. There are various kinds of accelerators.

Resources and Activites

CONCEPTS	RESOURCES
INTRODUCTION	Introduction The Atom and the Earth, pp. 170-73 FILM Atomic Power, B./W., 18 min. FILMSTRIP Fs 539 Man Discovers the Atom (49 Fr.)
Chapter 7	
1. X rays are a form of radiation: they are a part of the electromagnetic spectrum. 2. The discovery of X rays led to a study of radioactivity. 3. Becquerel and the Curies (Marie and Pierre) shared in the discovery of radioactivity. 4. Radioactive atoms give off alpha rays, gamma rays, and beta particles.	1, 2, 3, 4 The Atom and the Earth, pp. 174-77 A Sourcebook for the Physical Sciences, pp. 567-70 FILMS Atomic Radiation, B./W., 12 min. Our Friend the Atom, Part I, Col., 25 min.
5. An isotope is a type of an element; an isotope of an element differs from another isotope of the same atom only in atomic weight, that is, in the number of neutrons it contains. 6. An atom decays and becomes a different type of atom when its nucleus emits an alpha ray or a beta particle; such an atom is radioactive. 7. Half-life is the time it takes for one half of any given quantity of a radioactive element to change into a new element. 8. The decay of one atom leads to the decay of other atoms in a radioactive series. 9. Nuclear physicists write balanced equations to show nuclear reactions.	5, 6, 7, 8, 9 The Atom and the Earth, pp. 178-83 A Sourcebook for the Physical Sciences, pp. 563-67 TRANSPARENCIES (OH Project) Trns Atomic Series, (7, manual) FILMS Atomic Alchamist, B./W., 14 min. Cosmic Rays, Copy B, Col., 29 min. Strange Case of the Cosmic Rays, Part I, Col., 30 min. Strange Case of the Cosmic Rays, Part II, Col., 30 min. Radioactivity, Copy B, Col., 13 min. FILMSTRIPS Fs 539.752 Bombarding the Nucleus (48 Fr.) Fs 539.752 Radioactive Transmutation and Half-Life (52 Fr.) Fs 539.752 What Is Radioactivity? (51 Fr.)

ACTIVITIES

Introduction

a. Refer to teacher's edition, pp. 111-13.

b. Use the suggestions in the teacher's edition for Investigation 7 in the text to initiate individual student information gathering.

c. Bulletin board material or models on the cyclotron, atomic pile, atomic structure, atomic submarine, or related subjects will stimulate interest.

d. Use the indicated film or filmstrip to build interest.

1, 2, 3, 4

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. A "Radiation Detector Kit" (Geiger counter) is available from the Instructional Aids Distribution Center (see equipment section at front of this guide). It will demonstrate the Inverse Square Law, shielding effects, beta, and gamma radiation, and background radiation.

c. Refer to pp. 567-70 in A Sourcebook for the Physical Sciences for information and activities related to the Geiger counter; pp. 557-63 give other useful background information and activities related to these concepts.

5, 6, 7, 8, 9

a. Use activities suggested in the text and teacher's edition to develop these concepts.

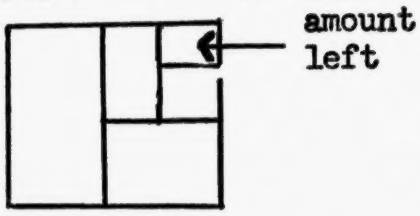
b. Set up a demonstration to show cosmic rays, alpha particles, and beta particles by using the Raymaster Cloud Chamber (available in each school). Use the operation manual of the Atomic Laboratories to set up the apparatus. Better performance can be obtained if the chamber is placed in a box large enough to contain both it and the dry ice. The box should have a hole in the side to admit light for viewing. The hole should be tightly covered with a transparent material such as glass or lucite. The top of the box should be removable and be provided with a circular hole centered around the cover glass of the cloud chamber retaining ring. This arrangement will minimize convection currents about the outside walls of the chamber, resulting in a more uniform temperature gradient from top to bottom of the chamber. Nigrosin, Rit, washable black ink, or India ink can be used if the black dye included in the original kit is gone. Either the portable light source or 2" x 2" slide projector can be used to illuminate the field. Part III of the manual presents the historical development and background information concerning the cloud chamber.

CONCEPTS	RESOURCES
	5, 6, 7, 8, 9 (Cont.)

c. Refer to pp. 566-67 in *A Sourcebook for the Physical Sciences* for a "moss spectrograph analogy" useful in explaining differences between isotopes; also, see pp. 563-65 for cloud chamber suggestions.

d. The concept of half-life might be illustrated by the teacher or a student as follows:

> Take a piece of paper and suggest that it represents a given quantity of radioactive material. Cut it in half at the end of a stated time interval (1 minute for example) and save one of the halves. Repeat several times after the same period of time. The time represents the half-life of the radioactive material; the piece of paper left represents the amount of radioactive material remaining in any given half-life period. (See p. 282 of the student text for an investigation illustrating the *rate* of decay in successive half-life periods.)



e. Work out some problems calculating the amounts of materials remaining after the natural transformation of some of the following elements:

Radioactive Transformations in the Series Uranium-Radium-Lead

Element	Group in Periodic Table	Atomic Mass	Half-life	Particle Emitted during Transformation
Uranium	VI	238	4.4×10^{9} years	Alpha
Uranium X_1	IV	234	24.5 days	Beta
Uranium X_2	V	234	1.14 min.	Beta
Uranium II	VI	234	3×10^{5} years	Alpha
Ionium (Thorium)	IV	230	8×10^{4} years	Alpha
Radium	II	226	1590 years	Alpha
Radon	0	222	3.82 days	Alpha
Radium A	VI	218	3.05 min.	Alpha
Radium B	IV	214	26.8 min.	Beta
Radium C	V	214	19.7 min.	Beta
Radium C'	VI	214	10^{-6} min.	Alpha
Radium D	IV	210	22 years	Beta
Radium E	V	210	4.9 days	Beta
Polonium	VI	210	140 days	Alpha
Lead	IV	206		

CONCEPTS	RESOURCES
CHAPTER 8 10. Nuclear fission is the splitting of an atom. 11. The splitting of an atom gives rise to a chain reaction. 12. Energy is released when an atom splits. 13. Nuclear fusion is the joining of one atomic nucleus with the nucleus of another atom. 14. Energy is released in the fusion of atoms.	10, 11, 12, 13, 14 The Atom and the Earth, pp. 189-93 CER KIT (in each school) Nuclear Energy FILMS A is for Atom, Col., 16 min. Atomic Energy - An Introduction, B./W., 11 min. Our Friend the Atom, Part II, Col., 25 min. Unlocking the Atom - Nuclear Fission, B./W., 20 min. Atom, B./W., 10 min. Living with the Atom, Col., 26 min. Reaching for the Stars, Col., 22 min. Three, Two, One, Zero, Part I, B./W., 28 min. Three, Two, One, Zero, Part II, B./W., 22 min. FILMSTRIPS Fs 539.76 Putting Atoms to Work (33 Fr.) Fs 539.76 Secret of Nuclear Energy (50 Fr.) Fs 539.76 Using Nuclear Energy (51 Fr.) SOUNDSTRIPS Ss 539.76 Peaceful Use of Atomic Energy, (Col., 1 record, 1 filmstrip, 2 study print sets, 23 manuals)

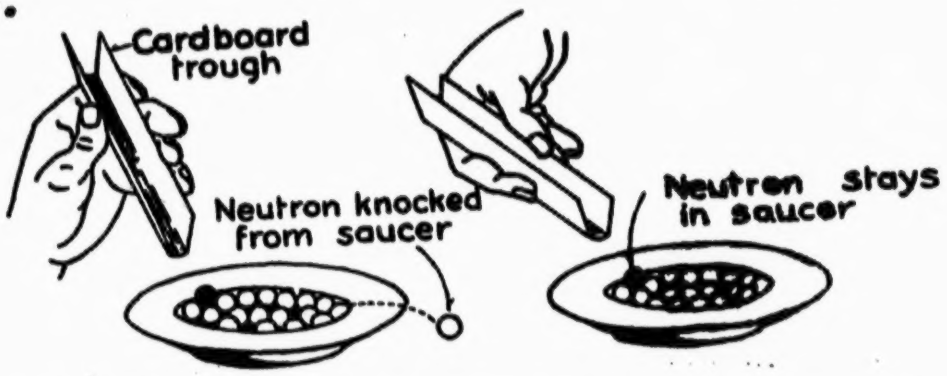
ACTIVITIES

10, 11, 12, 13, 14

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Use the following charts from the CER Kit "Nuclear Energy":
   Helium Atom
   Secret of Nuclear Energy
   Nuclear Fission Chain Reaction

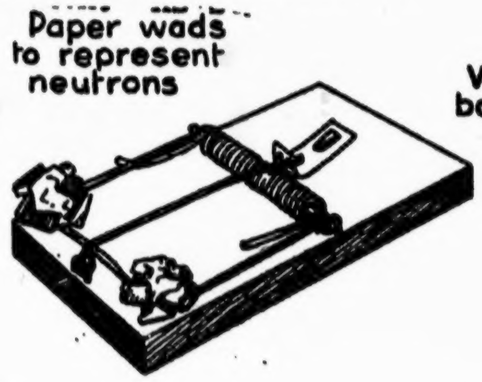
c. Use the simple apparatus shown in the accompanying diagram to illustrate "neutron capture." Place a dozen marbles in a saucer to represent the particles in a nucleus of U-238. Bend a piece of cardboard to form a trough. Hold the trough as shown and roll a marble down the incline. If the marble is going too fast, it will knock another marble from the "nucleus." If the speed is right, the marble will remain in the saucer and the U-238 will become plutonium (Pu-239).

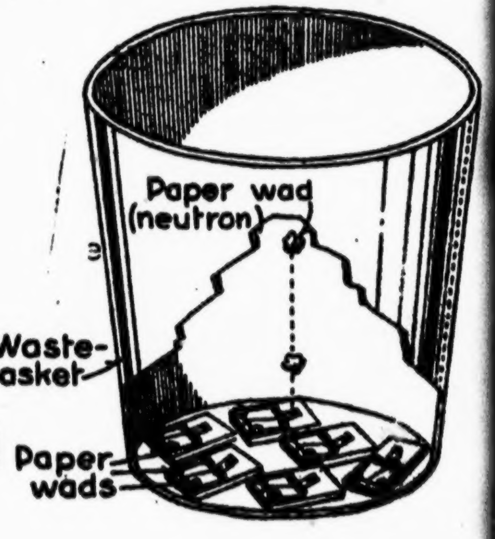


d. The principle of U-235 chain reaction can be demonstrated very dramatically by means of several mousetraps and a large wastebasket. Each mousetrap will represent an atom of U-235. When the mousetrap is set, it has energy just as as an atom of U-235 has.

Make a dozen paper wads each about one inch in diameter. These will represent neutrons. Set six mousetraps and place them very carefully in the bottom of the wastebasket. Opposite the trigger of each, place two paper wads as shown in the diagram.

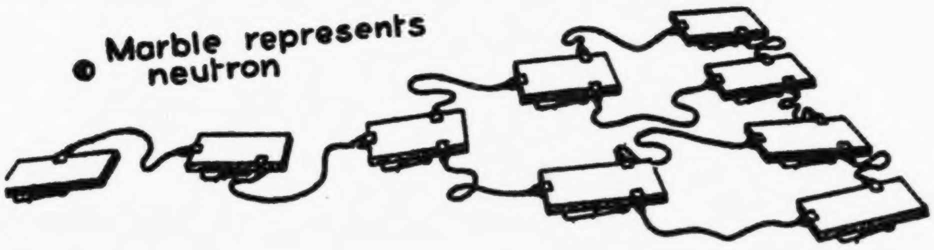
With everything in readiness, drop a paper wad neutron on the trigger of one of the mousetraps. If a direct hit is not scored on the first try, call attention to the fact that this often happens and that many neutrons are left over in a real chain reaction. As soon as a direct hit is scored, the paper neutrons will be set in motion and all the mousetrap atoms will give up their energy, accompanied by considerable clatter within the wastebasket.


Paper wads to represent neutrons



CONCEPTS	RESOURCES
15. A nuclear reactor is an "atomic furnace"; the nuclear reactor uses the energy of the atom to generate heat energy. 16. A nuclear reactor consists of six main parts; moderator, coolant, shielding, fuel rods, control rods, and heat exchanger. 17. Nuclear reactors are used to manufacture radioisotopes.	15, 16, 17 The Atom and the Earth, pp. 194-96 CER Kit (in each school) Nuclear Energy FILMS Atom Goes to Sea, B./W., 12 min. Atomic Furnaces, B./W., 14 min. Atomic Energy - Inside the Atom, Col., 13 min.
18. A particle accelerator accelerates atomic particles to tremendous velocities; these high speed particles then strike the nuclei of target atoms, causing them to split. 19. An accelerator is a research tool; it enables physicists to observe the behavior of nuclear particles. 20. There are various kinds of accelerators.	18, 19, 20 The Atom and the Earth, pp. 197-98 FILM Atomic Accelerators, B./W., 30 min.

e. The multiplying nature of the U-235 chain reaction can be further clarified by arranging set mousetraps as shown in the diagram. When a small object representing a neutron is dropped on the first trap, it springs and starts a chain reaction which passes on to the rest of the traps.



f. The following is the proton reaction theory of the fusion that occurs in the sun to release energy.

$$_1H^1 + {}_1H^1 \qquad H^2 + 1e^o + o.93 \text{ Mev.}$$

$$_1H^1 + {}_1H^2 \qquad {}_2He^3 + \text{ -ray} + 5.5 \text{ Mev.}$$

$$_2He^3 + {}_2He^3 \qquad {}_2He^4 + 2{}_1H^1 + 12.8 \text{ Mev.}$$

15, 16, 17

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Use the following charts from the CER Kit "Nuclear Energy":

Conventional vs. Nuclear Energy as a Source of Heat
Cutaway of a Reactor
Nuclear Reactor Fuel Element
Typical Nuclear Reactor Generating Plant
What is a Nuclear Reactor?

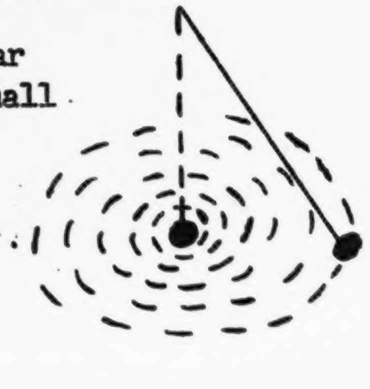
c. Discuss the progress of the nuclear power plant being built as San Onofre, California. Perhaps students who have visited it could bring in pamphlets from the visitor's center.

18, 19, 20

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer back to the film "Magnetic, Electric, and Gravitational Fields" (or show now) as an aid in understanding the operation of accelerators.

c. An analogy to a cyclotron can be demonstrated by a circular pendulum which is caused to move in widening circles by small taps at a given point on its orbit.



Suggested Topics For Student Investigations and Research Projects

Students may wish to choose one of the following topics for more detailed study and investigation.

-How "tagged" atoms have been used in medicines, agriculture, and industry.

-The possibility of atomic fuel replacing coal and oil.

-Obstacles faced in the use of atomic fuel in automobiles.

-The use of "atomic cocktails."

-The use of radioactive materials to determine flaws in welding and metal castings.

-The use of radioactive materials to gauge thickness of materials.

-The use of radioactive materials by the oil industry.

-The radiocarbon process of dating ancient objects.

-The work of the Curies, Becquerel, and Rutherford.

-Uses of atomic energy for producing power. A special report on the San Diego Gas and Electric Company plant at San Onofre would be especially interesting.

-The use of nuclear reactors: in producing radioisotopes and breeder reactors.

-The kinds of work being done at General Atomic.

Teacher's Evaluation*

A Guide for Teaching General Science 1-2 (8th)

UNIT VIII

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

5. Which work sheet should be deleted or changed?

6. What additional work sheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

*Please fill out this form after the unit is completed. Completed forms should be sent to the Science Specialist, Room 2041, Education Center, at the end of each semester during the school year 1967-68.

UNIT IX

ELECTRONICS

UNIT IX

ELECTRONICS
(2 Weeks)

Goals of the Unit

During his study of this unit, the student becomes aware of the wide variety of applications in our daily lives of the energy of moving electrons. The historical development of knowledge about the movement of free electrons through conductors and through space is stressed for the student. The study of vacuum tubes and transistors leads the student to an understanding of the operation of radio transmitters and receivers. The principles underlying television cameras and receivers are briefly presented for the student.

Teaching Suggestions

This unit follows the basic text, The Atom and the Earth, Chapter 9. A variety of audio-visual aids, supplementary materials, and suggested student activities are coordinated with the "Concepts to be Developed" section below.

It is recommended that the teacher carefully check the class background in electricity and concentrate on the areas the students are less familiar with. The short time allottment for this unit requires the best use of the time available. A pretest would be a useful introduction to this unit.

It is further recommended that Chapter 10, "The Electronic Computer," be omitted unless teacher and class interest and the time available indicate that it could be covered without detracting too much from the rest of the course. Most of the concepts in Chapter 10 are covered in junior high mathematics.

Books Referred to in This Unit

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the Physical Sciences. New York: Harcourt, Brace, and World, Inc., 1961.

Navarra, John G., et. al. The Atom and the Earth. New York: Harper and Row, 1965.

Wilson, Mitchell, and the editors of Life. Energy. New York: Time Incorporated, 1963.

Concepts to be Developed

CHAPTER 9

1. The electron is a particle of negative electricity.
2. Free electrons are apart from the atom and can give rise to an electric current.
3. Electrons have mass, velocity, and energy.
4. The emission of an electric current by a hot filament is known as the Edison effect.
5. Transistors and electron tubes can amplify current.

6. A diode serves as a rectifier; a rectifier changes alternating current into direct current.

7. A transistor is a semiconductor; a semoconductor behaves as a conductor under some circumstances and functions as an insulator under different conditions.

8. The transistor performs all the functions of an electron tube.

9. A radio microphone converts sound waves into electric impulses.

10. A radio transmitter converts electric impulses into radio waves.

11. A radio receiver converts radio waves into sound waves.

Resources and Activities

CONCEPTS	RESOURCES
INTRODUCTION	Introduction *The Atom and the Earth*, pp. 207-10 *Energy*, pp. 117-35 FILMS Mighty Atom, Col., 18 min. Communication: Story of Its Development, Col., 11 min.
CHAPTER 9 1. The electron is a particle of negative electricity. 2. Free electrons are apart from the atom and can give rise to an electric current. 3. Electrons have mass, velocity, and energy.	1, 2, 3 *The Atom and the Earth*, pp. 210-15 FILM Electrons at Work, Col., 14 min. FILMSTRIP Fs 537 Michael Faraday (24 Fr.) TRANSPARENCIES (OH Projector) Trns 537 Electricity (10, Manual)

ACTIVITIES

Introduction

a. Refer to Teacher's Edition, pages 145-47.

b. Set up a bulletin board depicting various applications of moving electrons and radio waves in radio, television, and computers.

c. The use of an oral review or "pretest" over such concepts as magnets, current electricity, an electric circuit, batteries, and so on, would establish the level of prior learning of the class.

d. Refer to pages 117-35 in Energy for material for students who need more background.

e. Show one or both of the suggested films to review prior learnings and build interest in this unit.

1, 2, 3

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer back to or use now the Van de Graaf generator available in each school to demonstrate properties of electrons.

c. Equipment is available in each school to demonstrate electrolysis and electroplating.

d. Use the electron discharge tube, along with the power supply and spark coil to operate it, that is available in each school to demonstrate cathode rays.

e. Review and/or demonstrate for the class the methods listed below of producing electricity. Equipment is in each school.

1. Friction: pith balls, rubber rod, cat's fur, glass rod, silk, Van de Graaf generator
2. Magnets: induction coil, hand generator with lamp
3. Chemicals: voltaic cell
4. Solar power: solar cell demonstrator
5. Thermoelectircity: Thermoelectric pair (use with galvanometer)

CONCEPTS	RESOURCES
4. The emission of an electric current by a hot filament is known as the Edison effect. 5. Transistors and electron tubes can amplify current. 6. A diode serves as a rectifier; a rectifier changes alternating current into direct current. 7. A transistor is a semiconductor; a semiconductor behaves as a conductor under some circumstances and functions as an insulator under different conditions. 8. The transistor performs all the functions of an electron tube.	4, 5, 6, 7, 8 The Atom and the Earth, pp. 215-21 A Sourcebook for the Physical Sciences, pp. 538-43, 547-51 CER Kit (in each school) Solid State Physics FILMS Basic Electronics, Col., 17 min. Diode: Principles and Applications, B./W., 14 min. Triode: Amplification, B./W., 14 min. Electrons and Electronics: An Introduction, B./W., 11 min. FILMSTRIPS Fs 621.38 What is Electronics: (49 Fr., Manual) Fs 621.3815 Electronic Tubes (33 Fr.) Fs 621.3815 Transistors (34 Fr.)
9. A radio microphone converts sound waves into electric impulses. 10. A radio transmitter converts electric impulses into radio waves. 11. A radio receiver converts radio waves into sound waves.	9, 10, 11 The Atom and the Earth, pp. 221-26 A Sourcebook for the Physical Sciences, pp. 537-38, 543-47, 551-54 FILM How Television Works, B./W., 10 min.

4, 5, 6, 7, 8

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to pages 538-43 and pages 547-51 in A Sourcebook for the Physical Sciences for background and activities about diodes, triodes, and transistors.

c. See the electronics teacher in your school, if old vacuum tubes and transistors are not available in the science department or from your students.

d. Use the following charts from the CER Kit "Solid State Physics":
Application of Solid State Devices
From Tubes to Transistors

9, 10, 11

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to pages 537-38, 543-47 and 551-54 in A Sourcebook for the Physical Sciences for background and activities about electromagnetic waves, radio, and television.

c. Discuss reasons for "static" on the car radio as you pass under a high-power line.

d. Compare the carrier waves used in AM and FM radio broadcasting.

Suggested Topics for Student Investigations and Research Projects

Students may wish to choose one of the following topics for more detailed study and investigation.

-Precautions against static electricity in gasoline tank trucks

-Precautions against static electricity in grain storage elevators

-Precautions against static electricity in factories

-Problems of static electricity in space flight

-Use of lightning rods

-Applications of electrostatics in smoke control

-Applications of electrostatics in the printing industry

EVALUATION SHEET

Teacher's Evaluation*

A Guide for Teaching General Science 1-2 (8th)

UNIT IX

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

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5. Which work sheet should be deleted or changed?

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7. Other suggestions.

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UNIT X

GEOSCIENCE--GEOLOGY, OCEANOGRAPHY, METEOROLOGY

UNIT X

GEOLOGY, OCEANOGRAPHY, METEOROLOGY
(7-8 Weeks)

Goals of the Unit

During his study of this unit, the student is introduced to the lithosphere, hydrosphere, and atmosphere. The interdisciplinary contributions of chemistry and physics to the study of these parts of the earth are emphasized to the student. Topics stressed include the origin, composition, and forces of the earth; rocks, minerals, and geologic changes in the earth; the formation, kinds, and movement of glaciers as well as the changes brought about by glaciers; the ocean floor, ocean cycles and circulation, and methods of collecting data in the ocean; and the composition and forces of the atmosphere involved in the weather. Many concepts previously studied by the student are set forth in new contexts in this unit.

Teaching Suggestions

This unit follows the basic text, The Atom and the Earth, Chapters 11, 12, 13, 14, and 15. Factual supplementary materials may be added by utilizing the supplementary text, Ramsey and Burckley, Modern Earth Science, 1965, Chapters 6 and 9-31. A variety of audio-visual aids, supplementary materials, and suggested student activities are coordinated with the "Concepts to be Developed" section on the following pages.

It is recommended that the teacher choose supplementary materials carefully in order not to get bogged down in the wealth of factual material available. A thorough understanding of the basic concepts in these areas prepares the student to study specific areas in detail in future courses and probably confuses him less than a mass of factual information would.

It is also recommended that the teacher be especially alert to new developments in the areas covered in this unit. Many newspaper and magazine articles may be used to enrich the text presentation and keep it up to date.

The new CER Module "Geology of San Diego County" is in preparation. The "Tour Guide" teacher's guide was completed May, 1967 and should be in the schools in September, 1967. This new resource may be referred to and used where appropriate in this unit.

Books Referred to in This Unit

Heller, Robert L. Geology and Earth Sciences Sourcebook for Elementary and Secondary Schools. New York: Rinehart and Winston, Inc., 1962.

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the Physical Sciences. New York: Harcourt, Brace, and World, Inc., 1961.

MacCracken, Helen D., et. al. Basic Earth Science. Chicago: The L. W. Singer Company, 1964.

Navarra, John G., et. al. Today's Basic Science: The Atom and The Earth. New York: Harper and Row, 1965.

Ploutz, Paul F., et. al. Laboratory Manual: Basic Earth Science. Syracuse, New York: The L. W. Singer Company, 1964.

Ramsey, William L. and Burckley, Raymond A. Modern Earth Science. Rinehart and Winston, Inc., 1961.

Thompson, Philip D., et. al. Weather. New York: Time, Incorporated, 1965.

Wilson, Harlan L. A Guide to Rocks, Minerals, and Fossils of San Diego. San Diego, California: San Diego City Schools, 1957.

Wilson, Harlan L. A Guide to Weather and Climate of San Diego. San Diego, California: San Diego City Schools, 1959.

Concepts to be Developed

CHAPTER 11

1. The earth is a planet in space; it is the fifth largest planet in the solar system.
2. Geodesy is the science of measuring the size of the earth and determining its shape.
3. The earth is an oblate spheroid; it is slightly flattened at the poles.
4. The circumference of the earth is about 25,000 miles; the calculated weight of the earth is about six sextillion tons.
5. Scientists estimate the age of the earth by means of radioactive dating; the earth is believed to be about 4.5 billion years old.
6. Various scientists have come forth with several theories to explain the origin of the earth.
7. Most scientists accept the dust-cloud hypothesis as an explanation of the earth's origin; according to the dust-cloud hypothesis, the sun and the planets condensed from an inter-stellar cloud of dust and gas.
8. Among the early theories concerning the earth's origin was the Kant-Laplace hypothesis; another theory is the planetesmial hypothesis put forth by T. C. Chamberlin and R. R. Moulton.
9. The lithosphere is the solid part of the earth; it consists of the crust, mantle, and core.
10. Seismic waves have given scientists information about the earth and its makeup.
11. Faulting causes earthquakes; the elastic rebound theory explains faulting.
12. Gravity is one of the forces of the earth.
13. Magnetism is one of the forces of the earth; a magnetic field surrounds the earth.

CHAPTER 12

14. A rock is a mass of minerals.

15. A mineral is an element or compound found in the earth; it is neither man-made nor the product of a living thing.

16. Many minerals have a crystalline structure; such minerals take the shape of a crystal.

17. A mineral can be identified by its chemical properties and physical properties.

18. There are three main kinds of rocks: igneous, sedimentary, and metamorphic.

19. The earth is constantly changing; geologic changes bring about a change in surface features.

20. Geologic changes are the result of building processes and leveling processes.

CHAPTER 13

21. A glacier is a moving sheet of ice resting high in the mountains or spreading across an arctic plain.

22. Snow is the raw material of a glacier; in order for a glacier to form, there must be abundant snowfall.

23. The recrystallization of snow produces a glacier.

24. Glaciologists study the structure and makeup of a glacier.

25. A glacier consists of two main parts: the zone of accumulation and the zone of ablation.

26. There are two main kinds of glaciers: the continental glacier and the valley glacier.

27. All glaciers are formed in areas above the snow line.

28. An iceberg can be formed when a chunk of ice breaks off a continental glacier at the coast and falls into the sea.

29. An iceberg floats because ice is not as dense as liquid water; about five-sixths of an iceberg is submerged.

30. Valley glaciers are classified according to their temperatures; there are warm glaciers and cold glaciers.

31. Lengthwise, a valley glacier is divided into two parts: the zone of accumulation and the zone of ablation.

32. A piedmont glacier is formed when a valley glacier advances beyond the foot of a mountain.

33. The cross section of a glacier reveals two main parts: the rigid zone and the plastic zone.

34. The rigid zone and the plastic zone differ in the way they move and in the speed of their movement; the rigid zone moves faster than the plastic zone.

35. The flow of a glacier is largely the recrystallization of ice; individual ice crystals glide, melt, and refreeze, giving rise to the movement of the glacier.

36. Glaciers erode the land.

37. Glaciers scar the terrain and carve out landforms.

CHAPTER 14

38. Oceanography is an interdisciplinary study.

39. The specialized branches of oceanography are physical oceanography, chemical oceanography, geological oceanography, and biological oceanography.

40. The floor of the ocean is irregular in form; it is a mass of plains, valleys, and mountains.

41. The main subdivisions of the ocean floor are continental shelves, continental slopes, and deep-sea basins.

42. The ocean is a storehouse of minerals; these minerals are cycled and recycled between the ocean and living things on land.

43. Currents flow through the ocean.

44. Oceanographers measure the depth of the ocean by means of a sonic depth recorder.

45. Oceanographers learn about the structure of the ocean floor by examining "core samples."

CHAPTER 15

46. Air is a mixture of gases consisting mostly of nitrogen and oxygen.

47. Air has the properties of a gas; it has pressure and can be compressed.

48. The oxygen cycle and the nitrogen cycle are essential to living things.

49. All matter consists of small particles called molecules, and these particles are constantly in motion.

50. At any given temperature, the pressure of a gas varies inversely proportional to the volume.

51. Under constant pressure, the volume of a given mass of gas is directly proportional to the absolute temperature.

52. Water evaporates from the ocean and moves into the atmosphere as water vapor.

53. Relative humidity expresses the amount of water the air holds in comparison to the maximum it can hold at a given temperature.

54. The atmosphere has an enormous mass.

55. The atmosphere consists of two large zones: the homosphere and the heterosphere.

56. The homosphere is subdivided into the troposphere, stratosphere, and mesosphere.

57. The heterosphere is subdivided into the nitrogen layer, the oxygen layer, the helium layer, and the hydrogen layer.

58. The atmosphere is the center of weather.

59. Four conditions of the atmosphere give rise to weather: heat, wind, moisture, and air pressure.

60. The general circulation of the atmosphere influences weather.

61. Air masses move across the earth in low-pressure systems and high-pressure systems.

Resources and Activities
See pages 198-228

CONCEPTS	RESOURCES
UNIT INTRODUCTION	Introduction The Atom and the Earth, pp. 262-66 FILMS Canyon Country, Col, 15 min. Rocky Mountains--The Continental Divide, Col, 22 min. Face of the Earth, Col, 13 min. FILMSTRIPS Fs 551.45 Desert Rocks and Minerals (29 Fr, Col.) Fs 917.94 Yosemite National Park, Copy B. (50 Fr, Col.)

ACTIVITIES

Introduction

a. Refer to teacher's edition, pp. 181-83.

b. Investigation 12, p. 264 in student text would be a particularly good introduction to the kinds of things to be studied in this entire unit. Allow students freedom in choosing topics.

c. List on the chalkboard and discuss some problems involving geology, for example:

Erosion by - Ocean waves
- Water and wind
- Mining
- Excavating for buildings
- Dams and roads
- Drilling for water and oil

d. Pupils who have visited interesting places could be asked to tell the class about them. Yellowstone National Park geysers, the Carlsbad Caverns, Oregon Caves, Lassen Volcanic National Park, Grand Canyon, etc. Bring out the pupil's ideas as to how they are formed.

e. Many excellent pictures are available for the bulletin board. A group selected to show the various topics to be studied during this unit might be arranged and used as a basis for discussion. Let students draw these and/or bring in snapshots. The graphic arts club or the photography club may make enlarged prints from students' negatives.

f. Individual pictues of geological phenomena might be displayed to the class and individuals asked to give their ideas about them.

g. A collection of rocks and minerals will usually start a lively discussion followed by student investigation of location, properties, and so on.

h. Show one or more of the suggested films and filmstrips to build general interest. Filmstrips or personal slides on other national parks could also be used.

i. Prout, Lynne L., Ringel, Robert C., and Sullivan, Raymond, Looking at Earth and Sky. Century Schoolbook Press: San Francisco, 1966, should be included in the classroom library for student as well as teacher use. This is a good source for the entire unit, and is a state adopted text for Grade 8.

j. Refer to the Appendix, pp.285-86 for maps of local areas to be used throughout the unit where appropriate. They may be Thermo-Faxed and used in a variety of types of lessons.

CONCEPTS	RESOURCES
CHAPTER 11 1. The earth is a planet in space; it is the fifth largest planet in the solar system. 2. Geodesy is the science of measuring the size of the earth and determining its shape. 3. The earth is an oblate spheroid; it is slightly flattened at the poles. 4. The circumference of the earth is about 25,000 miles; the calculated weight of the earth is about six sextillion tons. 5. Scientists estimate the age of the earth by means of radioactive dating; the earth is believed to be about 4.5 billion years old.	1, 2, 3, 4, 5 The Atom and the Earth, pp. 266-72 Basic Earth Science, pp. 64-65 Basic Physical Science, pp. 365-66 Modern Earth Science, pp. 90-97 A Sourcebook for the Physical Sciences, pp. 84-85 FILM Lattitude and Longitude, B./W., 10 min.

1, 2, 3, 4, 5

a. Use activities suggested in the text and teacher's edition to develop these concepts.

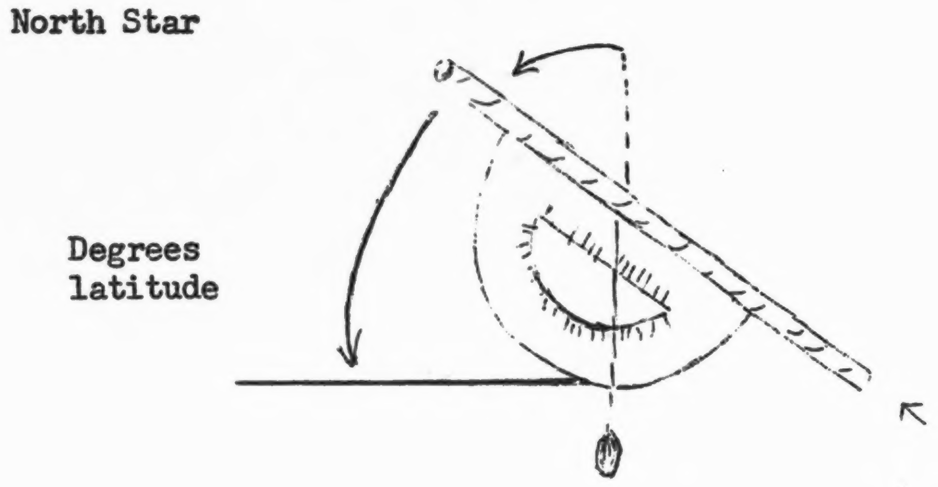
b. Refer to or do again the demonstration with the centrifugal hoop (Unit V, 4, 5, 6, 7, 8, 9, 10, d.) to illustrate the flattening of the poles of the earth.

c. Refer to Eratosthenes' measurment of the earth's circumference, teacher's edition, p. 185. Have student teams perform Investigation 1-1, "Measuring the Circumference of the Earth," 1965 edition of ESCP *Investigating the Earth, Lab Manual* (Appears on pp. 68-69 of hard-cover edition, ESCP *Investigating the Earth.* Boston: Houghton Mifflin Company, 1967).

d. Information on carbon dating may be found on pp. 365-66, *Basic Physical Science*, and pp. 64-65, *Basic Earth Science*.

e. Have students illustrate the use of a quadrant or sextant in measuring latitude.

To make a simple quadrant, students can tape a protractor to a drinking straw, as illustrated, with a weighted thread at the center point. Sighting at the North Star will give the angle A. Subtracted from 90 degrees, it will yield the latitude of your locality.



CONCEPTS	RESOURCES
6. Various scientists have come forth with several theories to explain the origin of the earth. 7. Most scientists accept the dust-cloud hypothesis as an explanation of the earth's origin; according to the dust-cloud hypothesis, the sun and the planets condensed from an interstellar cloud of dust and gas. 8. Among the early theories concerning the earth's origin was the Kant-Laplace hypothesis; another theory is the planetesmial hypothesis put forth by T. C. Chamberlin and F. R. Moulton.	6, 7, 8 The Atom and the Earth, pp. 273-76 Basic Earth Science, pp. 14-20 Geology and Earth Sciences Sourcebook, pp. 261-68 Modern Earth Science, pp. 81-82 FILMS The Earth, Our Planet, B./W., 20 min. The World is Born, Col, 20 min.

1, 2, 3, 4, 5 (continued)

f. Use the slated globe for developing the concept of the establishment of meridians of longitude and latitude. Point out the significance of the international date line. The diagram "Measurement of Latitude and Longitude," Appendix, p.287, can be used as a master for producing a spirit duplication master with the Thermo-Fax copying machine. The spirit duplicator may then be used to produce copies for student use.

g. Using the sample world globe diagram, Appendix, p. 288, as a model for making student work sheets, have the students locate a series of positions from a furnished list of latitude-longitude data. For example:

10° S Lat.	15° E Long.
50° N Lat.	30° E Long.
60° N Lat.	75° W Long.

(Hint: Similar points might be chosen so that the result outlines a familiar state or other item.)

A similar practice is to organize a "world tour" of positions on a world globe. Students can furnish a list of major cities and countries to visit, and supply the latitude-longitude positions of these cities. Perhaps several globes can be borrowed from various departments so all students may participate in small groups.

6, 7, 8

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Geology and Earth Sciences Sourcebook, Chapter 14, "The Origin of the Earth," may be of value with other ideas and activities.

CONCEPTS	RESOURCES
9. The lithosphere is the solid part of the earth; it consists of the crust, mantle, and core. 10. Seismic waves have given scientists information about the earth and its makeup. 11. Faulting causes earthquakes; the elastic rebound theory explains faulting.	9, 10, 11 The Atom and the Earth, pp. 276-80 Basic Earth Science, pp. 175-81, 86-88 Modern Earth Science, pp. 83-88 Geology and Earth Sciences Sourcebook,97 FILMS Hidden Earth, Col, 29 min. Interior of the Earth, Col, 14 min. What's Inside the Earth, Col, 18 min. Earthquakes, B./W., 10 min.
12. Gravity is one of the forces of the earth. 13. Magnetism is one of the forces of the earth; a magnetic field surrounds the earth.	12, 13 The Atom and the Earth, pp. 280-84 Basic Earth Science, pp. 346-68 FILM Magnetic, Electric, and Gravitational Fields, Col.

9, 10, 11

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. It may prove difficult to separate the study of earthquakes from the study of volcanoes and diastrophism in the section on "Geoloic Changes," Chapter 12, Concepts 19 and 20, pp. 302-05. Concepts 10 and 11 in the section "Earthquakes and seismology," Chapter 11, pp. 277-80 could be covered later with Concepts 19 and 20.

c. The CER Soundstrip "Mohole Project" provides a good review of Concept 9. It is suggested that the strip be shown completely and then individual frames repeated for emphasis of separate ideas.

d. Refer to p. 87 in Basic Earth Science for the construction of a simple seismograph. A more complex version from Geology and Earth Sciences Sourcebook, pp. 107-09, could be assigned to a student or group of students as an enrichment project. This could also be the basis for a science project.

12, 13

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to or show again the film "Magnetic, Electric, and Gravitational Fields" (listed previously in this guide).

c. Chapter 15 in Basic Earth Science, pp. 346-68, covers "Universal Gravitation" in detail.

CONCEPTS	RESOURCES
CHAPTER 12 14. A rock is a mass of minerals. 15. A mineral is an element or compound found in the earth; it is neither man-made nor the product of a living thing. 16. Many minerals have a crystalline structure; such minerals take the shape of a crystal. 17. A mineral can be identified by its chemical properties and physical properties. 18. There are three main kinds of rocks; igneous, sedimentary, and metamorphic.	14, 15, 16, 17, 18 The Atom and the Earth, pp. 289-302 Basic Earth Science, pp. 91-93, 97-119, 144-46, 156-65, 172-75 Laboratory Manual; Basic Earth Science, pp. 16-26, 87-91 Modern Earth Science, pp. 150-203 Geology and Earth Sciences Sourcebook, pp. 1-60, 199- 218 A Sourcebook for the Physical Sciences, pp. 64-70 A Guide to Rocks, Minerals, and Fossils of San Diego, pp. 22-23 FILMS Igneous Rocks, Col, 20 min. Rocks and Minerals, Col, 10 min. Birth of an Oil Field, Col, 31 min. Copper: Steward of the Nation, Col, 13 min. Copper: the Oldest Modern Metal, Col, 27 min. Petrified River: the Story of Uranium, Col, 28 min. Krystalos, Col, 11 min. Crystal Gazing, Col, 12 min. Gold and Gold Mining, Col, 19 min. Treasure of the Earth, Col, 11 min. Metals and Ores, Col, 11 min. Placer Gold, Col, 10 min. Steel, Col, 34 min. Steel and America, Col, 29 min. California and Its Natural Resources, Col, 40 min. Yosemite Is My Home, Col, 30 min. Aluminum: Metal of Many Faces, Col, 28 min.

14, 15, 16, 17, 18

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Mineral identification charts are available in most geology textbooks. Not too much time should be spent on this activity, however, although it is useful as an enrichment exercise for the more able or interested students.

c. The formation of crystals may be observed through a microscope or microprojector using the following procedures listed below. (Refer also to Geology and Earth Sciences Sourcebook, pp. 27-28, and/or Zim and Shaffer, Rocks and Minerals.)

-Sodium chloride crystals. Use a small amount of water and continue to add salt, while stirring, until no more salt will dissolve. Add a drop of the solution to a flat microscope slide. The heat from your light source will usually be enough to dry the solution. Dark cubic crystals should appear at the edge of the drop. Polaroid filters do not help in this demonstration.

-Silver crystals. Dissolve silver nitrate crystals in water. Place a small piece of copper foil on a flat slide and add a few drops of silver nitrate solution to the edge of the copper. Crystals resembling frost patterns will appear if the concentration of the solution is great enough. CAUTION: Silver nitrate is poisonous.

-Potassium dichromate crystals. Dissolve potassium dichromate crystals in water to form an orange solution. Yellow and orange crystals will form. Crossed polaroid filters will produce a dark background for the crystals. CAUTION: Potassium dichromate is poisonous.

-Thymol crystals. Dissolve thymol crystals in ethyl alcohol. Place a drop of the solution on a flat slide. Crystals form slowly in planes of terraced octahedrons. A highly concentrated solution is recommended for best results. Another method is to place a few crystals of thymol on a slide and heat gently. The crystals melt easily and reform in larger units. Polaroid filters have very little effect.

-Ammonium chloride crystals. Place a drop of ammonium chloride solution on a flat slide. Branching crystals will appear.

d. Pages 22 and 23 in Guide to Rocks, Minerals, and Fossils of San Diego show show minerals found in San Diego County. Field Trip Guide Book, San Diego State College, provides detailed area maps of San Diego County with mineral locations.

e. Refer to Laboratory Manual; Basic Earth Science, for the following student investigations:
    Lab 6, Growing Crystals, pp. 16-18
    Lab 7, Chemical Weathering-Limestone, pp. 19-20
    Lab 8, Igneous Rocks, pp. 21-22, 87
    Lab 9, Sedimentary Rocks, pp. 23-24, 89
    Lab 10, Metamorphic Process, pp. 25-26, 91

CONCEPTS	RESOURCES
	14, 15, 16, 17, 18 (Cont.) FILMSTRIPS Fs 662.363 Salt Fs 622.33 Coal Mining. Copy C Fs Box 551 Rocks and Minerals Group Fs 553.2 Natural Resources: Coal, Oil, Natural Gas Fs 553.4 Mineral Riches of America Fs 669.1 Chemistry of Iron Fs 669.1 Chemistry of Steel Fs 669.1 Iron and Steel 2x2 SLIDES 549 Minerals TRANSPARENCIES (OH Projector) Trns 552 Rock Cycle EXHIBITS Ex 549 Specimans Found in an Iron Mine Ex 553.6 Native Sulfur

14, 15, 16, 17, 18 (Cont.)

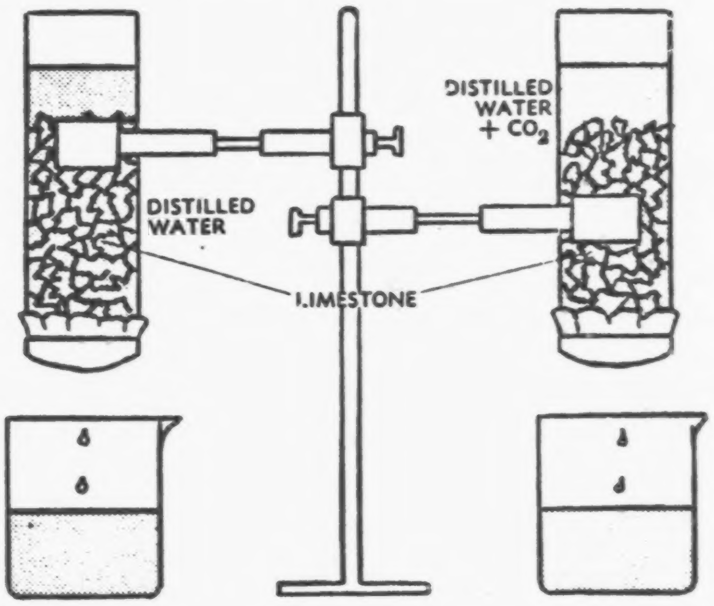
f. Use the mineral collections and the "Moh's Scale of Hardness Kit" available in each school.

g. Discuss the formation of caves. Have someone who has visited a cave describe what he saw. See Modern Earth Science, page 313.

h. Demonstrate how limestone can be dissolved by the action of acid. Use diluted hydrochloric acid (one part standard solution to ten parts water). Place marble chips in a container with the acid or use a medicine dropper and place drops of acid on limestone.

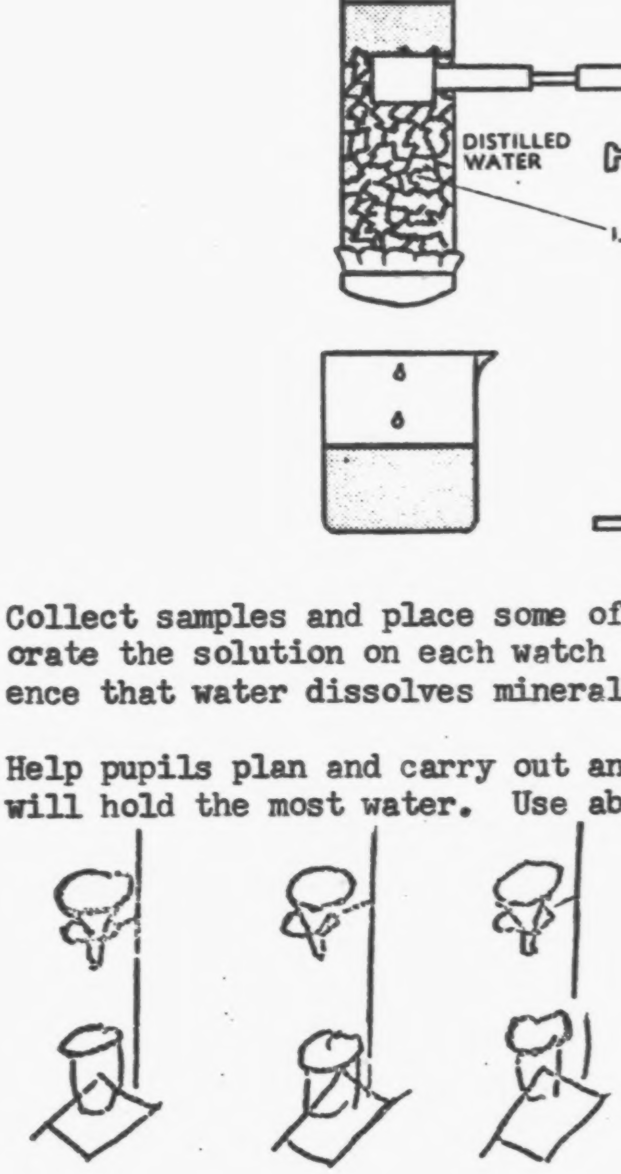
i. Show that water does contain dissolved minerals by evaporating some tap water and observing the material left. Evaporate an equal amount of distilled water for comparison. Be sure to rinse all containers with distilled water before using. This will remove most minerals.

j. Arrange the apparatus as shown in the diagram. To one tube, add distilled water; to the other add an equal amount of distilled water into which you have blown your breath for 3 minutes.



Collect samples and place some of each sample on separate watch glasses. Evaporate the solution on each watch glass to dryness; compare. Is there any evidence that water dissolves minerals from limestone?

k. Help pupils plan and carry out an investigation of soils to determine which type will hold the most water. Use about a quart of sandy soil, clay soil, and loam.



Use three funnels with filter paper or glass wool inside. Place smaples of soil inside and pour equal amounts of water over each sample. Collect the water going through the funnel in a beaker to measure the water-holding capacity of the soil. Simpler equipment such as plastic pill boxes or baby food jars may be used.

CONCEPTS	RESOURCES

14, 15, 16, 17, 18 (Cont.)

l. A Guide to Rocks, Minerals, and Fossils of San Diego, revised 1967, may instill interest concerning the local area. This reference may be used throughout the unit where appropriate.

m. Have a group of pupils arrange a display of rocks and minerals for the school display case. Mineral and rock clubs enjoy showing their products, especially to schools. Most every San Diego neighborhood has one or more rock club members; the teacher may contact them personally or the students may make the contacts.

n. The street level of the Museum of Natural History has an excellent display of local and worldwide minerals. Mineral and Gem Society, Spanish Village, Balboa Park, usually has a good display of minerals and equipment related to mineralogy.

o. Discuss the fluorescence of minerals. A fluorescent minerals kit has been assigned to each of the junior high schools.

CONCEPTS

19. The earth is constantly changing; geologic changes bring about a change in surface features.

20. Geologic changes are the result of building processes and leveling processes.

RESOURCES

19, 20

The Atom and the Earth, pp. 302-05
Basic Earth Science, pp. 21-29, 31-36, 42-47, 94-97, 151-54, 178-81
Modern Earth Science, pp. 210-328
Geology and Earth Sciences Sourcebook, pp. 63-126, 141-95, 293-340, 365-92
A Sourcebook for the Physical Sciences, pp. 57-64

FILMS

Earthquakes and Volcanoes, Col, 14 min.
Face of the Earth, Col, 12 min.
Mountain of Fire, Col, 11 min.
Birth of a Volcano, B./W., 10 min.
Conserving Our Soil Today, Col, 11 min.
World at Your Feet, Col, 20 min.
Understanding Our Earth: How Its Surface Changes, Col, 11 min.
Time Changes the Land, Col, 23 min.
River of Ice: Life Cycle of a Glacier, 2nd Ed., Col, 10 min.
Monument Valley, Col, 22 min.
In the Beginning: The Grand Canyon Story, Col, 28 min.
Canyon Country, Col, 15 min.

FILMSTRIPS

Fs 551 Changes in the Earth's Crust
Fs 551 Story of Mountains
Fs Box 551 Geomorphology: The Origin and Development of Land Forms
Fs 551.21 Story of Volcanoes
Fs 551.21 Volcanoes, Geysers, and Hot Springs
Fs 631.4 How Soil is Formed, Copy B
Fs 631.45 Wasted Soil and Water

2 X 2 SLIDES

551.2 Work of Earthquakes and Volcanoes

19, 20

a. Use activities referred to in the text and teacher's edition to develop these concepts.

b. Refer to pp. 76-77, Geology and Earth Sciences Sourcebook, for a demonstration volcano; pp. 77-80, for a model geyser. Many variations are possible, with a more simplified version probably most appropriate.

c. Additional information on volcanism may be found in Basic Physical Science, pp. 413-14.

d. The use of modeling clay in layers and an erosion table may be appropriate.

e. Topographic maps of the San Diego area or of some national parks may be used as enrichment materials.

f. Soak a piece of limestone and a piece of sandstone in water overnight. Remove from the water and dry with a paper towel. Now freeze both rocks for 24 hours. Examine the rocks just after the freezing time is over. Let the rocks thaw. Examine the rocks again.

g. Examine 12 small pieces of freshly broken and washed rocks. Place the pieces in a glass jar half filled with water. Screw on the lid and have a student shake the jar 100 times. Wrap jar in a towel to protect student if jar should break. Pour the water from the jar through a filter paper in a funnel. This will collect the minute particles formed from the larger pieces breaking. What percentage of the rocks was worn away?

h. Demonstrate how expansion and contraction due to heating and cooling of objects may cause fracture. Heat the end of a piece of glass tubing and carefully immerse it into cold water. The end will shatter. The same shattering may occur when a cold glass is immersed in hot water. Similar actions occur in nature. Have students discover examples. (EYE PROTECTIVE DEVICES REQUIRED.)

i. Demonstrate what happens to the volume of water when it freezes. Follow Experiment 2, page 142, Beauchamp. You may be able to use the homemaking department's refrigerator to freeze the water. This is a good homework assignment to be recorded and reported using the scientific method.

j. Bring in some examples of rocks covered with lichens to show how plants might help break up rock. (See pictures on p. 141, Beauchamp; p. 217, Davis.) Soak a bean seed overnight and then seal it in a 1" x 1" fresh plaster of paris block. Observe. Seed should break block in a day or two.

k. Make models in clay, plaster, or papier-maché to illustrate folding and faulting. Paint the various rock layers. See Modern Earth Science, Chapter 13, p. 210.

CONCEPTS	RESOURCES
	19, 20 (Cont.) TRANSPARENCIES (OH Projector) Trns 551.43 Mountains and Volcanoes Trns 551 Geology: Earth Movement and Mountain Building STUDYPRINT SP-S 551.3 Erosion EXHIBITS Ex 551.21 Volcanic Cinders From Lassen National Park Ex 551.21 Volcanic Clinkers Ex 551.21 Volcanic Unit Ex 551.21 Volcano in Eruption and Cross Section of Its Interior (diorama) Ex 551.4 Elementary Land Form Models

19, 20 (Cont.)

l. Water Erosion. Demonstrate how materials are sorted by water.

m. Wind Erosion. Demonstrate the work of wind in causing erosion by putting a pile of sand on the bottom of a large carton that has had the top and one side removed. Let an electric fan blow across the sand. Use different speeds. Observe the effects on the sand.

n. Diastrophism. Introduce the diastrophic earth movements of uplift, subsidence, and thrust. Students may wish to construct models with modeling clay or plaster of paris colored with food coloring. (See Modern Earth Science, p. 213.)

o. Isostasy. Demonstrate the hypothesis of isostasy or isostatic equilibrum by floating a small cork and a large cork in water. Place some small weights on the large one. Remove the weights one at a time and put them on the small one. The former will rise a little and the latter will sink. An explanation of this demonstration may be found in Ramsey, Modern Earth Science, pp. 214-15.

p. Refer to Laboratory Manual; Basic Earth Science, for the following activities:
   Lab 2, Acids, Bases, and the Soil, pp. 5-7
   Lab 3, Soil and It's Development, pp. 8-10

q. Have the pupils examine the soil at different depths where a new cut has been made for erecting buildings or putting in a new road. Make a sketch of the cut to show the different layers and show it to the class. How much topsoil is present? How much topsoil is present in our yards in San Diego? What is the role of earthworms and other soil organisms in forming topsoil?

r. Have some of the pupils bring in samples of soil from near their homes. Include samples of clay or adobe ("dobe") soil and of good garden soil. Examine it as to color, texture, presence of sand, pebbles, plant roots, ants, etc. Samples from both the surface and about a foot or more below the surface should be compared.

s. To demonstrate soil erosion, have students collect one-quart containers of different soils and keep a record of where they came from. Have students construct a V-shaped trough four feet long. This should be made out of 1" x 8" boards. Take the class out to the school garden area and place pint-size quantities of soil on the tilted trough. Pour measured amounts of water over the soil to observe the rate the soils wash away. Have the students record information in notebook and also note the water being used is watering plants in the garden (an example of water conservation).

t. A guest speaker or current literature from the San Diego County Department of Agriculture (telephone 298-4181) would be stimulating to the students to find out just what is currently being done in this area in the way of soil conservation.

CONCEPTS

CHAPTER 13

21. A glacier is a moving sheet of ice resting high in the mountains or spreading across an artic plain.

22. Snow is the raw material of a glacier; in order for a glacier to form, there must be abundant snowfall.

23. The recrystallization of snow produces a glacier.

24. Glaciologists study the structure and makeup of a glacier.

25. A glacier consists of two main parts: the zone of accumulation and the zone of ablation.

26. There are two main kinds of glaciers: the continental glacier and the valley glacier.

27. All glaciers are formed in areas above the snow line.

28. An iceberg can be formed when a chunk of ice breaks off a continental glacier at the coast and falls into the sea.

29. An iceberg floats because ice is not as dense as liquid water; about five-sixths of an iceberg is submerged.

30. Valley glaciers are classified according to their temperatures; there are warm glaciers and cold glaciers.

31. Lengthwise a valley glacier is divided into two parts: the zone of accumulation and the zone of ablation.

32. A piedmont glacier is formed when a valley glacier advances beyond the foot of a mountain.

33. The cross section of a glacier reveals two main parts: the rigid zone and the plastic zone.

RESOURCES

21 through 37

The Atom and the Earth, pp. 308-22
Basic Earth Science, pp. 47-49, 124-33
Geology and Earth Sciences Sourcebook, pp. 179-96
Modern Earth Science, pp. 332-49

FILMS
- Glacier Park Studies
- Great Lakes: How They Were Formed, Col, 11 min.
- Secrets of the Ice, Col, 27 min.
- Understanding Our Earth: Glaciers, B./W., 10 min.
- Geological Work of Ice, 2nd Ed., Col, 11 min.
- How We Know About the Ice Ages, Col, 16 min.
- River of Ice: Life Cycle of a Glacier, 2nd Ed., Col, 10 min.

FILMSTRIPS
- Fs 551.31 Story of Ice and Glaciers
- Fs 551.31 Work of Snow and Ice
- Fs 551.313 Ice-carved Mountains

2 X 2 SLIDES
- 551.31 Work of Glaciers

STUDYPRINT
- SP-S 551.31 Glaciers

TRANSPARENCIES (OH Projector)
- Trns 551.31 Geology: Ice and Water Erosion

4

ACTIVITIES

21 through 37

a. Use activities referred to in the text and teacher's edition to develop these concepts.

b. Refer to the structure and interaction of water molecules studied earlier in this course. Particularly review the films "Chemistry of Water" and "Structure of Water."

c. Refer to or do now the activities relating rock fracture to freezing-thawing actions under Concepts 19 and 20 of this unit.

d. Trace the concept of glacial action from past geologic history in leading up to the warming trend. Chapter 6 of Basic Earth Science covers existing polar glaciers well.

e. Geology and Earth Sciences Sourcebook, pp. 179-96, has many ideas and activities for presentation of these concepts.

f. Make a model of a glaciated region; show moraines, drumlins, outwash plains. See Modern Earth Science, Chapter 19, p. 332, and Geology and Earth Science Sourcebook, pp. 179-98.

CONCEPTS	RESOURCES
34. The rigid zone and the plastic zone differ in the way they move and in the speed of their movement; the rigid zone moves faster than the plastic zone. 35. The flow of a glacier is largely the recrystallization of ice; individual ice crystals glide, melt, and refreeze, giving rise to the movement of the glacier. 36. Glaciers erode the land. 37. Glaciers scar the terrain and carve out landforms.	
CHAPTER 14 38. Oceanography is an interdisciplinary study. 39. The specialized branches of oceanography are physical oceanography, chemical oceanography, geological oceanography, and biological oceanography.	38, 39 The Atom and the Earth, pp. 326-29 Basic Earth Science, pp. 141-42 FILM Science of the Sea, Col, 19 min. FILMSTRIPS Fs 551.46 Oceans, Copy C Fs 551.46 Turn to the Ocean SOUNDSTRIPS (Also in schools) CER Oceanography Series (7 records, 6 Filmstrips, 6 Manuals, 16 Charts, 3 Study Print Sets) Seelab II (Col, 1 Record, 1 Filmstrip, 2 Manuals, 2 Study Print Sets, 6 Charts) STUDY PRINTS SP-S 551.46 What Is Oceanography?
40. The floor of the ocean is irregular in form; it is a mass of plains, valleys, and mountains. 41. The main subdivisions of the ocean floor are continental shelves, continental slopes, and deep-sea basins.	40, 41 The Atom and the Earth, pp. 330-35 Basic Earth Science, pp. 142-46 Modern Earth Science, pp. 470-74 Laboratory Manual; Basic Earth Science, pp. 27-29, 93 FILMSTRIP Fs 551.46 Landscapes of the Sea

38, 39

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Stress the interdisciplinary aspects of oceanography.

c. Refer to the emergence of San Diego as a center of oceanographic research. Perhaps students have visited and could tell about one of the following:
   Scripps Institute of Oceanography, UCSD
   Naval Oceanographic Research
   Sea World exhibits of marine life

d. A variety of bulletin board material should be available from students, magazines, newspapers, etc.

40, 41

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to Laboratory Manual; Basic Earth Science, for the following activity:
   Lab 11, Topography of the Ocean, pp. 27-29, 93

c. Discuss the principle of isostasy in explaining the formation of ocean basins. (Refer to Concepts 19, 20, activity "o" this unit. Also, see Geology and Earth Sciences Sourcebook, pp. 158-59.)

CONCEPTS	RESOURCES
42. The ocean is a storehouse of minerals; these minerals are cycled and recycled between the ocean and living things on land. 43. Currents flow through the ocean.	42, 43 The Atom and the Earth, pp. 335-38 Basic Earth Science, pp. 147-51, 156-66 Modern Earth Science, pp. 356-63, 474-78, 480-92 Laboratory Manual; Basic Earth Science, pp. 30-31 Geology and Earth Sciences Sourcebook, pp. 159, 162-66, 168-75 FILMS Ocean Currents, Col, 17 min. Restless Sea, Part I, Col, 30 min. Tides of the Ocean, Col, 16 min. FILMSTRIP Fs 551.46 Mighty Currents of the Sea TRANSPARENCY (OH Prohector) Trns 551.46 Ocean Currents
44. Oceanographers measure the depth of the ocean by means of a sonic depth-recorder. 45. Oceanographers learn about the structure of the ocean floor by examining "core samples."	44, 45 The Atom and the Earth, pp. 338-41 Basic Earth Science, pp. 151-56 Modern Earth Science, pp. 467-70 FILMS Challenge of the Oceans Oceanography: Science of the Sea Restless Sea, Part II What's Under the Ocean? STUDY PRINTS SP-S 551.46 Exploration of Inner Space SP-S 551.46 New Portrait of Our Planet

ACTIVITIES

40, 41 (Cont.)

d. Stress the different kinds of marine life at different depths in the ocean.

42, 43

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to Laboratory Manual; Basic Earth Science, for the following activity:
Lab 12, Temperature and Water Current, pp. 30-31

c. Refer to Geology and Earth Sciences Sourcebook, p. 159, for background on the source of the water in the oceans; also, see pp. 162-66, 168-75 for information and activities related to currents and wave action.

44, 45

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Various oceanographic research instruments might be available for display from students' parents who work in oceanography.

c. Refer to up-to-date items in magazines, newspapers, and television programs.

CONCEPTS

CHAPTER 15

46. Air is a mixture of gases consisting mostly of nitrogen and oxygen.

47. Air has the properties of a gas; it has pressure and can be compressed.

48. The oxygen cycle and the nitrogen cycle are essential to living things.

49. All matter consists of small particles are constantly in motion.

50. At any given temperature, the pressure of a gas varies inversely proportional to the volume.

51. Under constant pressure, the volume of a given mass of gas is directly proportional to the absolute temperature.

RESOURCES

46, 47, 48, 49, 50, 51

The Atom and the Earth, pp. 344-54
Basic Earth Science, pp. 200-03
Modern Earth Science, pp. 498-503
Weather, pp. 8-33
A Sourcebook for the Physical Sciences, pp. 324-34

FILM
Inconstant Air, Col, 29 min.

ACTIVITIES

46, 47, 48, 49, 50, 51

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. A well-arranged bulletin board that contains illustrative material pertaining to storms, clouds, and other phenomena of the air is recommended. (Excellent pictures are to be found in Life magazine for June 8, 1953, "The World We Live In: How Air Was Created, Structure of Atmosphere, What Makes Wind Blow, Storms and Rainfall.")

c. A barometer, thermometer, psychrometer, and anemometer may be displayed.

d. A bulletin board that outlines the elements of weather--air temperature, air pressure, the winds and the water in the air--would aid the presentation of this chapter.

e. Refer to the appendix page 289, "Selected Publications on General Weather Science Study," for information on ordering applicable items from the United States Government Printing Office.

f. Have students construct a circle graph to show the percentages of the several gases that make up the air. Refer to the table in the student text, p. 347, or Modern Earth Science, p. 499.

g. Discuss some of the variable components of air: water vapor, ozone, ammonia, hydrogen sulfide, sulfur dioxide, sulfur trioxide, carbon monoxide, radon, dust (soot, rock, sea, salt, etc.).

h. The amount of dust in the air can be measured by setting out jars, containing 1/3 distilled water at each location where dust-fall measurements are desired. The jars should be 6 feet or more above ground. Leave the jar exposed for 30 days. Maintain constant water level. Evaporate the water from the jar and weigh the residue. Measure the area of the jar in sq. cm. Calculate dust-fall in mg/cm^2. Compare to 1 mg/cm^2 = 0.286 tons per sq. mi.

i. Refer to pp. 324-334 in A Sourcebook for the Physical Sciences for illustrations of air pressure and its effects. Magdeburg Hemispheres, barometer tubes, vacuum pumps, and model lift and force pumps are available in each school.

j. Do not stress Charles' and Boyle's gas laws too much; they will be covered in detail in General Science 4, 9th Grade.

k. Refer to previous work in this course on the kinetic theory and Brownian Motion.

CONCEPTS	RESOURCES
52. Water evaporates from the ocean and moves into the atmosphere as water vapor. 53. Relative humidity expresses the amount of water the air holds in comparison to the maximum it can hold at a given temperature. 54. The atmosphere has an enormous mass.	52, 53, 54 The Atom and the Earth, pp. 354-56 Basic Earth Science, pp. 219-26 Modern Earth Science, pp. 504-11, 522-34 Weather, pp. 80-105 A Sourcebook for the Physical Sciences, pp. 40-47 Laboratory Manual; Basic Earth Science, pp. 46-54, 99-104 FILMS Water and Life, Col, 30 min. Treasures in Snow, Col, 6 min. Nature's Plan, Col, 14 min. It's the Humidity, Col, 13 min. Clouds Above, Col, 10 min. FILMSTRIPS Fs 551.57 Mystery of Rain Fs 551.57 Wonders of Snow STUDY PRINTS SP-S 551.57 Cloud Code Chart SP-S 551.57 Cloud Forms SP-S 551.572 Familiar Cloud Forms 2 x 2 SLIDES 551.57 Art in Nature: Clouds and Sky 551.57 Story of the Clouds
55. The atmosphere consists of two large zones: the homosphere and the heterosphere. 56. The homosphere is subdivided into the troposphere, stratosphere, and mesosphere. 57. The heterosphere is subdivided into the nitrogen layer, the oxygen layer, the helium layer, and the hydrogen layer.	55, 56, 57 The Atom and the Earth, pp. 356-58 Basic Earth Science, pp. 204-06 Modern Earth Science, pp. 503-04 FILMSTRIPS Fs 551.51 Atmosphere Fs 551.51 Earth's Atmosphere Fs 551.5 Canopy of Air

52, 53, 54

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Illustrate various forms of precipitation as suggested in the following sources:
   Basic Earth Science, pp. 220-21, 226 (cloud formation)
   A Sourcebook for the Physical Sciences, pp. 45-47

c. A psychrometer and a hygrometer are available in each school to make relative humidity determinations. Refer to pp. 40-44 in A Sourcebook for the Physical Sciences if their instruction sheets are lost.

d. Relate the equalization of temperatures due to large bodies of water to California and San Diego. Compare summer and winter temperature ranges of San Diego to El Cajon.

e. Explain the "greenhouse effect" and its importance in nature. Relate it also to the world's industrialization.

f. Demonstrate the effect of temperature on evaporation. Set up a controlled experiment by pouring the same amount of water into two beakers of the same size. Place one beaker in the sun, and leave the other in the shade away from heat.

g. Study evaporation as a cooling process. Fasten a piece of absorbent cotton around the base of a thermometer and saturate with either alcohol or carbon tetrachloride.

h. Refer to pp. 368-69 in student text for additional information on cloud types.

i. Refer to Laboratory Manual; Basic Earth Science for the following activities:
   Lab 18, Measuring Relative Humidity, pp. 46-48,99
   Lab 19, Cloud Formation, pp. 49-51, 101
   Lab 20, Measuring Precipitation, pp. 52-54, 103-104

55, 56, 57

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Discuss the variation of air temperature with increase in altitude. Stress that the high temperatures recorded in certain upper atmosphere layers are a measure of the energy of individual molecules or atoms, but that these are so few molecules per unit of volume a person would not be kept warm.

c. Point out why temperature is not a measure of the total heat possessed by any object, i.e., a cup of boiling water does not contain as much heat as a gallon of lukewarm water.

CONCEPTS

58. The atmosphere is the center of weather.

59. Four conditions of the atmosphere give rise to weather: heat, wind, moisture, and air pressure.

60. The general circulation of the atmosphere influences weather.

61. Air masses move across the earth in low-pressure systems and high-pressure systems.

RESOURCES

58, 59, 60, 61

The Atom and the Earth, pp. 359-62
Basic Earth Science, pp. 206-219, 230-53
Modern Earth Science, pp. 513-19, 537-63
Weather, pp. 35-79, 152-93
A Sourcebook for the Physical Sciences, pp. 38-40, 48-54
Geology and Earth Sciences Sourcebook, pp. 127-40
Laboratory Manual; Basic Earth Science, pp. 37-45, 55-56, 95, 105, 123-24

FILMS
Unchained Goddess, Part I, Col, 30 min.
Unchained Goddess, Part II, Col, 30 min.
Great Winds - Distribution of Pressure and Winds, B./W., 10 min.
Great Winds - General Circulation, B./W., 10 min.
Origins of Weather, Col, 13 min.
How Weather Is Forecast, B./W., 10 min.
Reading Weather Maps, Col, 14 min.
Weather, Breath of Life, Col, 28 min.
Weather Scientists, Col, 14 min.

FILMSTRIPS
Fs 551.5 Air and Weather
Fs 551.5 Weather and the Jet Stream
Fs 551.51 Atmosphere and its Circulation
Fs 551.51 Maelstroms of the Air
Fs Box 551.59 Changing Weather
Fs 551.55 Tornadoes: What They Are and What To Do About Them
Fs 551.591 Weather, Copy E

TRANSPARENCIES (OH Projector)
Trns. 551.5 Meteorology
Trns. 551.51 The Mind Belts
Trns. 551.591 The United States Weather M

STUDY PRINTS
SP-S 551.5 Weather
SP-[illegible] 551.59 Weather and Climate

58, 59, 60, 61

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Relate heating of air, its moisture content, and gravity to variations in air pressure and the formation of air currents and winds.

c. Have students compare radiation, convection, and conduction of heat in terms of molecular motion, speed, and substances in which they occur. The insulating properties of a thermos can be used as a good example.

d. Describe the air found in a polar continental air mass, polar maritime air mass, tropical continental air mass, and a tropical maritime air mass. Discuss how a warm front and a cold front are formed. Compare them in regard to size, type of weather, cloud types, types of air present. (The filmstrip box set "Changing Weather" provides excellent coverage of these topics.)

e. The San Diego Union publishes a weather map each day. A smaller map shows the expected weather over the United States on that day. Students should be encouraged to bring in these maps and to learn to interpret them.

f. A daily weather chart, showing barometric pressure, temperature, and relative humidity of the outside air, and cloud forms, could be kept by the students.

g. Discuss the kinds of storm centers formed by fronts. Show how these affect San Diego. Refer to Guide to Weather and Climate of San Diego.

h. A student activity illustrating the effect of the earth's rotation on wind direction (Ferrel's Law) appears on p. 49 of A Sourcebook for the Physical Sciences.

i. Refer to Laboratory Manual; Basic Earth Science, for the following student activities:
    Lab 15, Measuring Wind Velocity, pp. 37-40, 95
    Lab 16, Measuring Air Pressure, pp. 41-43
    Lab 17, Heating of Air by Convection, pp. 44-45
    Lab 21, Constructing a Weather Station, pp. 55-56, 105, 123-24

Suggested Topics For Student Investigation and Research Projects

Students may wish to choose one of the following opics for more detailed study and investigation.

- Weather satellites
- Rainmaking
- Fog dispersal
- Air pollution
- Long-range weather forecasting

- Weather control for crop protection
- Roger Revelle
- Earth cross section
- IGY and IGC
- Major earthquakes

- Volcanology
- Seismology
- Seismograph
- Soil investigation
- The Ice Age

- Glaciers
- Fossel identification
- Indian relics
- Geologic time line
- Radioactive carbon dating

- Early man
- Darwin and H.M.S. Beagle
- Sir Charles Lyell
- Carolus Linnaeus
- Rock or mineral collection

- Extinct animals
- Coal industry
- Oil industry
- Development of life through fossils

Teachers' Evaluation*

A Guide for Teaching General Science 1-2 (8th)

UNIT X

EVALUATION SHEET

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

5. Which work sheet should be deleted or changed?

6. What additional work sheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

*Please fill out this form after the unit is completed. Completed forms should be sent to the Science Specialist, Room 2041, Education Center, at the end of each semester during the school year 1967-68.

UNIT XI

FROM ATMOSPHERE TO SPACE

UNIT XI

FROM ATMOSPHERE TO SPACE

(2 Weeks)

Goals of the Unit

During his study of this unit, the student applies many of the concepts he has learned in physical science to a study of "supersonic flight," "rockets and rocketry," and "satellites and communications." The excitement and challenge of flight and space exploration appeal to the student and help emphasize the practical applications rockets and satellites have and how they will contribute to our way of living in the years ahead.

Teaching Suggestions

This unit follows tha basic text, The Atom and the Earth, Chapters 17 and 18. A variety of audio-visual aids, supplementary materials, and suggested student activities are coordinated with the "Concepts to be Developed" section below and and on the following pages.

It is recommended that the teacher by especially alert to new developments in the areas covered in this unit. Many newspaper and magazine articles may be used to enrich and keep the text presentation up to date.

Books Referred to in This Unit

Joseph, Alexander, et. al. Teaching High School Science: A Sourcebook for the Physical Sciences. New York: Harcourt, Brace, and World, Inc., 1961.

Navarra, John G., et. al. Today's Basic Science: The Atom and the Earth. New York: Harper and Row, 1965.

Concepts to be Developed

CHAPTER 17

1. Aerodynamics is the study of air flow.
2. Four forces act upon an airplane in flight; these forces are gravity, lift, thrust, and drag.
3. For every action, there is an opposite and equal reaction.
4. A supersonic aircraft flies faster than sound.
5. The gas molecules of air carry pressure waves which we hear as sound waves.
6. The speed of sound varies with air temperature and altitude.
7. A measurement of Mach 1 indicates that an airplane is flying at the speed of sound; at Mach 2, the airplane is flying at twice the speed of sound.

8. At less than the speed of sound, an airplane sets up a normal pressure wave (sound wave); this wave clears a path for the airplane as it advances through the air.

9. Flying at the speed of sound, an airplane catches up with its own pressure wave; it smashes into the forward air, creating a tremendous shock wave.

10. When the airplane exceeds the speed of sound, the shock wave spreads out and moves along with the aircraft; the turbulence subsides.

11. A missle is anything thrown as a weapon; the rocket is a missle when used as a weapon.

12. A guided missile is an aerial vehicle directed to its target while in flight.

13. Some guided missiles are propelled by jet engines; such missiles have rudders, elevators, and ailerons.

CHAPTER 18

14. A rocket carries its own oxygen; it is not dependent upon the atmosphere for the firing of its engine.

15. A propellant consists of a fuel and an oxidizer; the oxidizer contains oxygen.

16. A liquid-propellant rocket uses a liquid fuel and a liquid oxidizer; a solid-propellant rocket burns a solid propellant consisting of both fuel and oxidizer.

17. Newton's third law of motion explains the lift-off of a rocket; for every action there is an equal and opposite reaction.

18. Mass ratio is the relationship of the weight of a rocket to its own weight plus the weight of its propellant and payload.

19. The mass ratio of a rocket determines its velocity.

20. The greater the exhaust velocity, the greater is the forward velocity of the rocket itself.

21. In rocketry, thrust is a capability to move weight; the thrust of a rocket is measured in pounds.

22. The clustering of engines increases the thrust of a rocket.

23. Specific impulse is a measure of a rocket's performance.

24. Specific impulse is the number of pounds of thrust obtained for each pound of propellant burned in one second.

CHAPTER 19

25. The moon is a natural satelite of the earth.

26. Such satellites as Telstar and Tiros are artificial earth satellites; they are man-made moons.

27. Gravity holds an artificial earth satellite in orbit; gravity pulls the satellite around the earth.

28. A certain velocity is required to keep a satellite in orbit at a specified altitude.

29. As the altitude of a satellite increases, the size of its orbit increases.

30. Telemetry is the transmission of physical data from a source of information to a point some distance from the source.

31. The requirements of a telemetry system are (1) a signal, (2) a means of transmission, and (3) the conversion of the signal into a readable message.

32. There are three kinds of telemetry: mechanical, electrical, and radio.

33. Communications is a method of sending information from place to place.

34. Microwaves are extremely high-frequency radio waves.

35. Microwaves travel in a straight line and do not follow the curve of the earth; relay towers are used to transmit microwave signals across the country.

36. A communications satellite serves as a "microwave relay tower" in space.

Resources and Activities
See page 236

CONCEPTS	RESOURCES
INTRODUCTION	Introduction *The Atom and the Earth*, pp. 372-376 FILM Air Age, B./W., 26 min. FILMSTRIPS Fs 629.1388 Flight to Mars Fs 629.1388 Man's Preparation for Space Travel Fs 629.1388 Space Travel A.D. 2000 STUDY PRINTS SP-S 629.109 Fifty Years of Powered Flight SP-S 629.109 Historic Planes (10) Sp-1 629.109 Story Map of Flying
CHAPTER 17 1. Aerodynamics is the study of air flow. 2. Four forces act upon an airplane flight; these forces are gravity, lift, thrust, and drag. 3. For every action there is an opposite and equal reaction.	1, 2, 3 *The Atom and the Earth*, pp. 376-82 *A Sourcebook for the Physical Sciences*, pp. 580-85 FILMS Man in Flight, Col., 35 min. Air in Action, Col., 10 min. Operation Jetliner, Col., 17 min. FILMSTRIPS Fs 533.6 Overcoming Gravity (50 Fr.) Fs 629.12 Controlling Airplanes (50 Fr.) Fs 629.13 Man in Flight (49 Fr.) Fs 629.13 Man Learns to Fly (49 Fr.) Fs 629.132 Jet Age Flight (32 Fr.) STUDY PRINTS SP-S 629.13 Flight by Instrument Sp-O 629.13 History of Flight (Col.)

ACTIVITIES

Introduction

a. Refer to teacher's edition, pages 269-71.

b. Organize a bulletin board showing recent improvements in airplanes and spacecraft.

c. Show one of the suggested filmstrips and/or film.

d. A field trip or visit to the Aerospace Museum in Balboa Park would be a good introductory or culminating activity for this section.

1, 2, 3

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Students may have model airplanes they have built that could be displayed and/or demonstrated for the class.

c. Refer to pages 580-85 in A Sourcebook for the Physical Sciences for information and activities related to: lift, drag, air speed, stress on flying planes, control surfaces, and building a wind tunnel.

CONCEPTS	RESOURCES
4. A supersonic aircraft flies faster than sound. 5. The gas molecules of air carry pressure waves which we hear as sound waves. 6. The speed of sound varies with air temperature and altitude. 7. A measurement of Mach 1 indicates that an airplane is flying at the speed of sound; at Mach 2, the airplane is flying at twice the speed of sound. 8. At less than the speed of sound, an airplane sets up a normal pressure wave (sound wave); this wave clears a path for the airplane as it advances through the air. 9. Flying at the speed of sound, an airplane catches up with its own pressure wave; it smashes into the forward air, creating a tremendous shock wave. 10. When the airplane exceeds the speed of sound, the shock wave spreads out and moves along with the aircraft; the turbulence subsides.	4, 5, 6, 7, 8, 9, 10 The Atom and the Earth, pp. 383-88 FILM Starfighter, B./W., 30 min. CER MODULE (proposed) Aircraft in the Space Age
11. A missile is anything thrown as a weapon; the rocket is a missile when used as a weapon. 12. A guided missile is an aerial vehicle directed to its target while in flight. 13. Some guided missiles are propelled by jet engines; such missiles have rudders, elevators, and ailerons.	11, 12, 13 The Atom and the Earth, pp. 388-89 FILMS Atlas Project Film Reports, Col., 8 min. On Target: Atlas ICBM, Col., 30 min. FILMSTRIP Fs 623.4519 Thor Missile Story

ACTIVITIES

4, 5, 6, 7, 8, 9, 10

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Review the basic concepts relating to producing and transmitting sound studied in Unit IV of this guide, "Biophysics of Sound."

c. Ask students to look for current magazine or newspaper articles about "sonic boom" shock wave effects.

d. Use currently available information on the progress of the SST supersonic airliner development.

11, 12, 13

Use activities suggested in the text and teacher's edition to develop these concepts.

CONCEPTS	RESOURCES
CHAPTER 18	
14. A rocket carries its own oxygen; it is not dependent upon the atmosphere for the firing of its engine. 15. A propellant consists of a fuel and an oxidizer; the oxidizer contains oxygen. 16. A liquid-propellant rocket uses a liquid fuel and a liquid oxidizer; a solid-propellant rocket burns a solid propellant consisting of both fuel and oxidizer.	14, 15, 16 The Atom and the Earth, pp. 393-99 FILMS Rockets: Principles and Safety, Col., 11 min. Jet Propulsion, Col., 12 min. Rockets: How They Work, Col., 14 min. CER MODULE (proposed) Propulsion Systems
17. Newton's third law of motion explains the lift-off of a rocket; for every action there is an equal and opposite reaction. 18. Mass ratio is the relationship of the weight of a rocket to its own weight plus the weight of its propellant and payload. 19. The mass ratio of a rocket determines its velocity. 20. The greater the exhaust velocity, the greater is the forward velocity of the rocket itself. 21. In rocketry, thrust is a capability to move weight; the thrust of a rocket is measured in pounds. 22. The clustering of engines increases the thrust of a rocket. 23. Specific impulse is a measure of a rocket's performance. 24. Specific impulse is the number of pounds of thrust obtained for each pound of propellant burned in one second.	17, 18, 19, 20, 21, 22, 23, 24 The Atom and the Earth, pp. 399-406 A Sourcebook for the Physical Sciences, pp. 585-87 FILMS Exploring Space, Col., 26 min. New Frontiers in Space Screen News Digest, Vol. 3, Issue 9, B./W., 22 min. Bunker Hill, 1964 Race for Space, Part I, B./W., 29 min. Race for Space, Part II, B./W., 25 min. CER MODULE (in school) Space Science FILMSTRIPS Fs 629.1333 Flying with Jets and Rockets (50 Fr.) Fs 629.1333 Leaving the World (41 Fr.)

ACTIVITIES

14, 15, 16

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Review the concepts relating to the formation of chemical compounds studied in Unit VII of this course, "Introductory Chemistry Concepts."

17, 18, 19, 20, 21, 22, 23, 24

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Use the soundstrip "From Drawing Board to Launching Pad" in the CER Kit "Space Science."

c. Many students will be able to bring to class more current information concerning space flight problems. Use this source to full advantage.

d. NASA films are available through the Instructional Aids Distribution Center periodically. Notification will be forthcoming from the Science Specialist's office.

e. Refer to pages 585-87 in A Sourcebook for the Physical Sciences for information and activities relating to "thrust" and to operating rocket engines.

CONCEPTS

CHAPTER 19

25. The moon is a natural satellite of the earth.

26. Such satellites as Telstar and Tiros are artificial earth satellites; they are man-made moons.

27. Gravity holds an artificial earth satellite in orbit; gravity pulls the satellite around the earth.

28. A certain velocity is required to keep a satellite in orbit at a specified altitude.

29. As the altitude of a satellite increases, the size of its orbit increases.

RESOURCES

25, 26, 27, 28, 29

The Atom and the Earth, pp. 411-18
A Sourcebook for the Physical Sciences, pp. 97-100

FILMS
- Screen News Digest, Vol. 5, Issue 5, B./W., 22 min.
- Exploring the Moon, Col., 16 min.
- Trip to the Moon, Col. 16 min.
- Man and the Moon, Col., 20 min.
- Screen News Digest, Vol. 8, Issue 6, B./W., 22 min.
- Earth Satellites: Explorers of Outer Space, Col., 17 min.
- Explorer in Space, B./W., 10 min.
- Exploring by Satellite, Col., 28 min.
- Screen News Digest, Vol. 4, Issue 1, B./W., 22 min.
- Screen News Digest, Vol. 5, Issue 1, B./W., 22 min.
- Satellites: Stepping Stones to Space, Col., 18 min.
- Telstar, Col., 27 min.
- Eyes in Outer Space, Col., 26 min.

FILMSTRIPS
- Fs 523.3 Exploring the Moon
- Fs 523.3 Man and the Moon
- Fs 629.1388 Exploring the Moon, Copy B
- Fs 629.1388 Flight Around the Moon
- Fs 629.1388 Rocket to the Moon
- Fs 629.1399 Earth Satellite
- Fs 629.1388 Information from Satellites
- Fs 629.1388 New Frontiers in Space
- Fs 629.1388 Space Satellites

STUDY PRINTS
- SP-S 629-1388 Space Vehicles Today and Tomorrow
- SP-O 629.1388 Space Age
- SP-S 629.1388 Moon Exploration (Part I: Instrumented)
- SP-S 629.1388 Moon Exploration (Part II: Manned)

CER MODULES
- Unmanned Earth Orbiting Satellites (proposed)
- Unmanned Exploration of the Moon, Sun, and Planets (proposed)

ACTIVITIES

25, 26, 27, 28, 29

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. Refer to the concepts on gravity and motion developed in Unit V of this course, "Astronomy and Life in Space"; the concepts on communication developed in Unit IX of this course, "Electronics"; and the concepts on meteorology developed in Unit X of this course, "Geoscience."

c. Refer to NASA information on Ranger, Surveyor, Lunar Orbiter, and Project Apollo.

d. National Geographic Magazine back issues contain a wealth of information for this section.

e. Refer to pages 97-100 in A Sourcebook for the Physical Sciences for information on satellites, their trajectories, how to chart a satellite, and how to calculate the period of a satellite.

CONCEPTS

30. Telemetry is the transmission of physical data from a source of information to a point some distance from the source.

31. The requirements of a telemetry system are (1) a signal, (2) a means of transmission, and (3) conversion of the signal into a readable message.

32. There are three kinds of telemetry: mechanical, electrical, and radio.

33. Communications is a method of sending information from place to place.

34. Microwaves are extremely high-frequency radio waves.

35. Microwaves travel in a straight line and do not follow the curve of the earth; relay towers are used to transmit microwave signals across the country.

36. A communications satellite serves as a "microwave relay tower" in space.

RESOURCES

30, 31, 32, 33, 34, 35, 36

The Atom and the Earth, pp. 419-21

FILMS
Space Scientist, Col., 11 min.
Science in Space, Col., 29 min.

CER KIT
Space Science (in each school)
Telemetry and Guidance Systems (proposed)

ACTIVITIES

30, 31, 32, 33, 34, 35, 36

a. Use activities suggested in the text and teacher's edition to develop these concepts.

b. The use of computers could be referred to at this point, and Chapter 10, "The Electronic Computer," in The Atom and the Earth assigned as extra credit. A soundstrip, "Computers, Numbers, and People," is available in each school in the CER Kit "Space Science."

c. Use the soundstrip "Communication by Satellite" from the CER Kit "Space Science."

d. Use current information available from NASA, magazines, newspaper articles, and students' parents.

Suggested Topics For Student Investigations and Research Projects

Students may wish to choose one of the following topics for more detailed study and investigation.

-Sir Isaac Newton

-Dr. Robert H. Goddard

-Johannes Kepler

-Aristotle's hypothesis of free-falling bodies

-Galileo's use of the inclined plane in developing the law of free-falling bodies

-Universal law of gravitation

-Newton and calculus

-Progress in United States and Russia in space exploration

-The different types of lunar probes: fly by, orbiter, impact, hovering, landing

-Launching a rocket toward the East to take advantage of the earth's rotation

-Methods of navigation in space

-Radio tracking of satellites

-Satellite and space probe chart

-Balloon altitude records

-Solid vs. liquid fuel rockets

Teachers' Evaluation*

A Guide for Teaching General Science 1-2 (8th)

UNIT XI

1. List the title of any visual aids which you feel are inadequate or misplaced. (Specify)

2. List any titles which should be added to the audio-visual list.

3. List any demonstrations and/or laboratory exercises which proved unsatisfactory. Please explain.

4. What additional demonstrations and laboratory exercises should be added to this unit? Please describe or submit draft.

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5. Which work sheet should be deleted or changed?

6. What additional work sheets should be added to this unit? Please describe or submit draft.

7. Other suggestions.

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SCIENCE - ORIENTED WORD PARTS

Prefixes and Suffixes

aero --	Pertaining to or concerned with aeronautics or airplanes (aeroplanes)
anthropo --	Gr. anthropos <man; like man; human
anti --	Against; opposed to; opposite to; equal to; like; mutually
archeo --	Gr. archaios, ancient; a combining form
astro --	Gr. astronomia <astron, <aster, star
bi, bio --	Gr. bios, life; a combining form
cyclo --	Gr. kyklos, circle; a combining form
derm, derma, dermato --	Gr. derma, <dero, skin, flay
entomo --	Gr. entoman, an insect
ethnico, ethno --	Gr. ethnos, race or nation; ethnic, a combining form
geo --	Gr. ge, earth; a combining form
glacio --	L. glacies, ice; a combining form
graphy --	Description, writing; L. graphia, <Gr. graphia, writing; <grapho, write
hem, hema, hemato -	Gr. haima, blood; combining forms
herpeto --	Gr. herpeton, reptile <herpo, creep; a combining form
ichthy, ichthyo --	Gr. ichthys, a fish; a combining form
logy --	A science; Gr. -logia <logos, speech, <lego, say, speak; study of
meter --	That by which a thing is measured; L. metrun Gr. <metron, measure
micre --	Gr. mikros-smikros, small
oid --	Like; resembling; having the form of; Gr. oedies, <odes, <eidos, form, <root of idein, sec.
ology --	See logy; Gr. o not used

ornith, ornitho --	Gr. ornis (ornith), bird; combining forms
paleo, pale --	Gr. palaios, ancient, old; combining forms
phylo --	Gr. phylon, phyle, tribe <phyo, produce; a combining form used chiefly in biology
physio --	Gr. physics, nature; a combining form
scope --	Manifester; indicator: chiefly in names of instruments of observation, properly those that indicate or aid in the observation of something without measuring it; Gr. skopos, watcher
toxico --	Gr. toxicon, toxicos -- poison, orig. a substance for smearing on arrows; combining forms
zo, zoo --	Gr. zoon, animal <zaro, live; combining forms in biology and zoology

Note: Gr. Greek; L. Latin.

FIELDS OF SCIENCE

aeronautics --	The branch of science which investigates floating in or navigating the atmosphere.
anatomy --	The study of the structure of living things; now a part of biology. (Gr. *anatome*, cutting up)
anthropology --	The science concerned with man's entire history but usually narrowed to man's place in nature. (Gr. *anthropos*, man, *-logy*, science or study)
archeology --	The science which investigates ancient remains.
architecture --	The science and art of planning and creating buildings.
astronomy --	The science that investigates the celestial bodies, their motions, magnitudes, distances, and physical construction. (Gr. *astronomia* ⟨*astron*, ⟨*aster*, star - *nemo*, distribute).
bacteriology --	The department of biology which deals with bacteria and related forms of life.
ballistics --	The science which investigates the impact, path, and velocity of projectiles.
biochemistry --	A branch of chemistry relating to vital processes, their mode of action, and their products.
biology --	The science of living things; study of plants and animals and their relationship.
botany --	The division of biology that investigates plant life; . . . "a study of biology with plants as illustrative materials."
chemistry --	The science that investigates matter and its structure; taking substances apart (analysis) and putting substances together in different combinations (synthesis). (Gr. *chemeia*, infusion)
conchology --	The branch of zoology that studies mollusks with reference to their shells. (Gr. konchē, shell+ *-logy*)
cybernetics --	A comparative study of electrical circuits of the human nervous system and of electronic calculators; new approach to study of human mind and behavior. (Gr. *kybe*, the head; *kybernetes*, a helmsman)
dermatology --	The branch of medical science which relates to the skin and its diseases.
ecology --	The division of biology and botany which deals with the relation of an organism to its environment. (Gr. *oikos*+ *-logy*)

FIELDS OF SCIENCE (Cont.)

entomology --	The branch of zoology that investigates insects.
ethnology --	The study and classification of different races of man.
genealogy --	The science that traces pedigrees. (Gr. genealogia <genea, race)
geography --	The science that describes the surface of the earth.
geology --	The science that studies the constitution and structure of the earth.
geometry --	The branch of pure mathematics that investigates space and its relations.
glaciology --	A subdivision of geology emphasizing glaciers.
hematology --	The branch of medical science that specializes in the blood, its formation, functions, and diseases.
herpetology --	The branch of zoology that emphasizes reptiles.
horticulture --	That department of the science of agriculture which relates to the cultivation of gardens or orchards. (L. hortus, garden, cultura, cultivation, <colo, till)
ichthyology --	The branch of zoology that emphasizes fishes.
immunology --	The division of medical science concerned with protection from disease; prevention and control of disease. (L. immunis, <in, not -- munis, service)
mammalogy --	The branch of zoology that is concerned with the mammalia. (L.L. mammalis, L. <mamma, breast)
mathematics --	The science that investigates quantity or magnitude, and of their measurements. (L. mathematicus, <Gr. mathematikos <manthano, learn)
metallurgy --	The art or science of economically extracting metals from ores; divided into chemical, physical or mechanical areas (Gr. metallourges, working metals, <metallon, perhaps orig. 'ore').
meteorology --	The science that investigates the phenomena of the atmosphere. (Gr. meteoros, lofty, high; meteoros, unsettled, in suspense, high in air).
oceanography --	The branch of physical geography studying oceanic life and phenomena (Gr. okeanos, ocean); oceanology -- the science that treats the ocean.
ornithology --	The branch of zoology concerning birds.

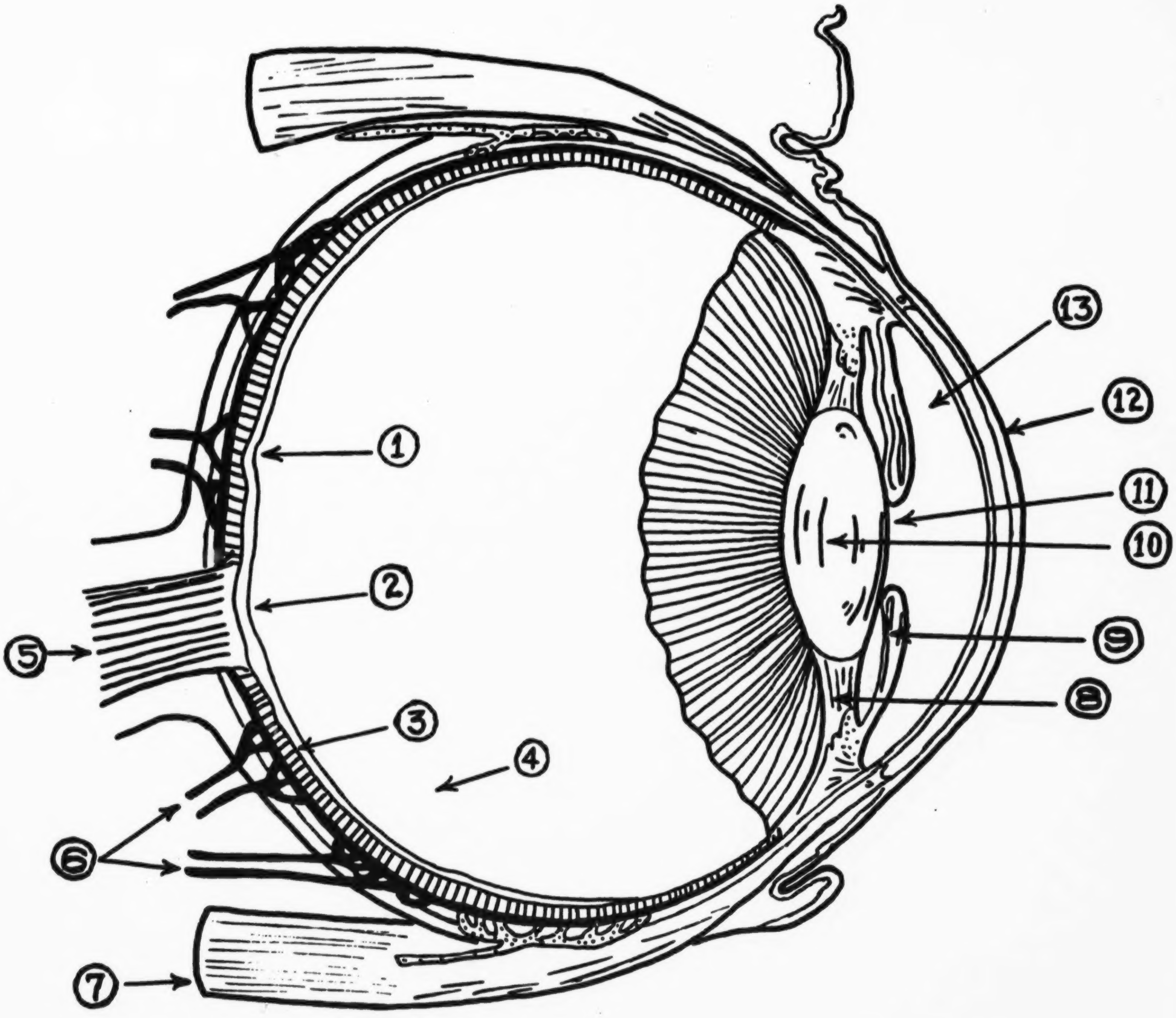
FIELDS OF SCIENCE (Cont.)

paleontology --	The branch of biology concerning ancient life of the globe or of fossil organisms, either plant or animal.
physics --	The science of energy.
physiology --	The branch of biology with respect to the vital phenomena manifested by animals or plants; the science of organic functions as opposed to organic structures.
toxicology --	The branch of medical science referring to poisons.
zoology --	The science of animal life; a division of biology that concerns animals as to structure, functions analysis, nomenclature, and classification.

Note: Gr., Greek; L. Latin.

HUMAN EYE

NAME ____________________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NAME - FUNCTION

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THE EYE AND VISION

Teacher Information

This exercise is designed to help the student understand the structure and the function of the eye and the part the brain plays in vision.

Materials:

- Flashlight or lamp - several will be sufficient since students may alternate their use.
- Cardboard, 8" x 6" marked as shown on page 260 - 1 per team
- Sheet of paper - 1 per team

This exercise should be done after the students are somewhat familiar with the anatomy of the eye.

THE EYE AND VISION

Exercise

NAME ____________________

Vision depends upon two things: (1) the reaction of the eye to the light that reaches it and (2) the way the brain interprets what the eye sees. This exercise will help you to understand more about the structure of the eye, how it operates, and the part the brain has in seeing.

Work with a partner. You will use both yourself and your partner as experimental subjects. If you wear glasses, you may have to remove them for parts of the exercise.

1. Have your partner close his eyes and cover them tightly with his hands for 30 seconds. Then have him open them and uncover them while you watch closely his pupils and his irises. What do you see? ____________________

   ____

   Repeat, reversing roles with your partner. What is the value of the reflex you have observed? ____

   ____

2. Have your partner hold a cardboard vertically along his nose and between his eyes. Shine a light into his left eye while observing the pupil and iris of his right. Repeat, reversing eyes. Then repeat reversing roles. Describe the results and explain.

3. While observing your partner's eyes, have him look through the windowpane at a distant scene. Then have him look at a speck on the same pane. Describe what you see. ____

   ____

4. Hold your forefinger about 8 inches from your nose. Close first one eye, and then the other. Repeat several times. Describe and explain. ________

   ____

5. The part of the retina where the optic nerve leaves it has no rods or cones. You cannot see with this part, so it is called the blind spot. Hold the diagram below directly in front of your right eye, and focus that eye on the cross. Close the left eye. Although you are looking at the cross, the circle will also be in your range of vision. Move the diagram away from and toward your eye and find the spot where the circle disappears. Repeat the procedure with the left eye. Explain. ____________________

   ____

Why don't we ordinarily notice the blind spot? ______________________

____

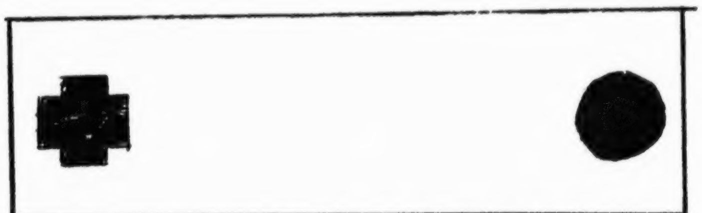


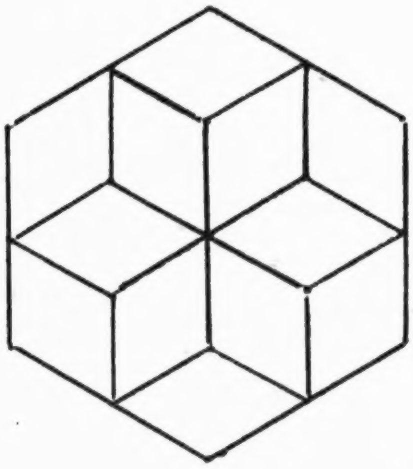
Diagram to demonstrate the blind spot

6. Most people use one eye more than the other. They call that eye the dominant eye. You can identify your dominant eye. Using a sheet of paper, make a tube one or two inches in diameter. Look at some object across the room, then raise the tube at arms length so you are looking through the tube at the object. Holding the tube steady, close first one eye and then the other. Which is your dominant eye? ______________ How do you know? ______________________________

7. With one hand, hold the tube close to one eye. Hold the other hand several inches in front of the other eye. Do you see a hole in your hand? _____ Explain. ______________________________

8. Looking for a long time at a bright light or at bright colors tires the retina. After such activity, we see afterimages. Have your partner time this activity. Look at a bright light or a bright picture for 20 seconds, then at the wall or ceiling. Describe the afterimage. ______________ How long does it last? ______________________________

9. Look at the diagram below for 30 seconds. What do you see? ______________ Explain. ______________________________

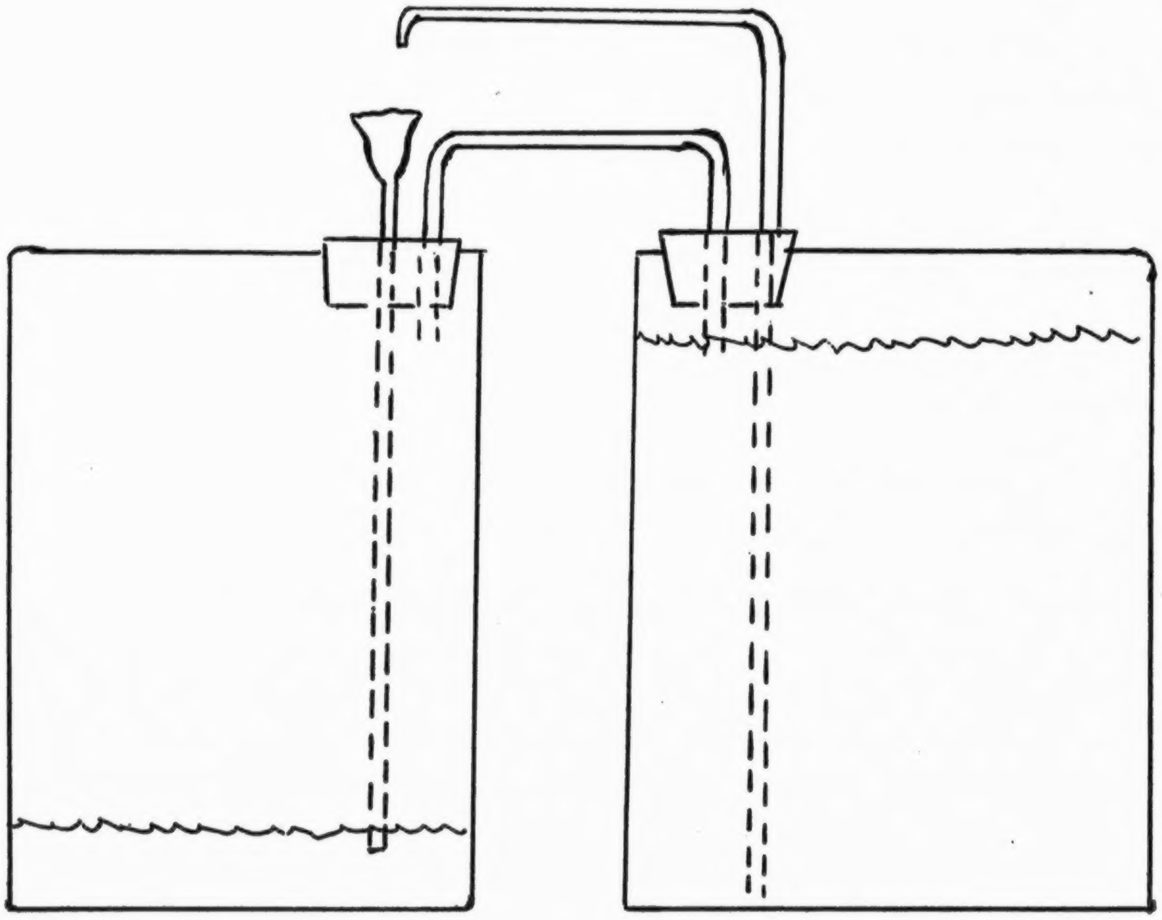


10. Try to classify each of the results in 1 through 9 above as to whether it is a: (1) response of the eye to light, or (2) an interpretation of the brain, or (3) neither.

TWELVE SUGGESTED PROBLEMS STRESSING THE SCIENTIFIC PROCESS

Perpetual Drip
(teacher demonstrates)

Materials:	2 one-gallon cans (duplicator fluid cans are good.) glass tubing and thistle tube 2-hole rubber stoppers
Directions:	Arrange equipment as shown in the diagram, using gallon cans. DO NOT reveal to the class the inner arrangement of tubing; this is for them to figure out. To start the action, a small quantity of water is poured in the thistle tube. Require students to write up their explanation of what is occurring and what forces are involved (gravity, air pressure).



Note: The container on the left contains only enough water to cover lower end of the thistle tube; the container on the right is nearly full.

How Does Size Affect Sound?

Materials: Several tin cans of different sizes; grains of sand.

Directions:

1. Turn the tin cans upside down and place some grains of sand on the upturned bottoms of each can.
2. Tap each can hard, several times, with a pencil.
3. Listen to the sounds made by each can and notice what happens to the grains of sand.
   (The larger cans make a low sound, the smaller cans make a high sound, the sand bounces farther on the larger cans than it does on the smaller ones.)

Explanation: Striking the tin cans caused the metal to vibrate. The larger the piece of metal, the slower it vibrated, and the lower sound it made. A large bass drum makes a lower sound than a small snare drum because its membrane vibrates slower.

What Are the Chemical Properties of Carbon Dioxide?

Materials: Baking soda, vinegar, glass tumbler, match.

Directions:

1. Place a small amount of baking soda in a glass tumbler.
2. Pour some vinegar on the baking soda. (Bubbles of carbon dioxide gas appear.)
3. Hold a lighted match in the bubbles. (The burning match is extinguished.)

Explanation: Carbon dioxide does not burn and prevents other things from burning. Carbon dioxide is used in some fire extinguishers.

What Types of Material Transmit Sound Best?

Materials: A watch, a yardstick, a metal rod about three feet long (a curtain rod will do), a piece of wrapping paper or newspaper about three feet long, a piece of cloth about three feet long.

Directions:

1. Place the watch at one end of a yardstick and place the other end of the yardstick against your ear.
   (You should be able to hear the watch ticking.)
2. Repeat the experiment with the metal rod, the paper and the cloth. (You can hear the watch ticking through the metal rod but not through the paper or the cloth.)

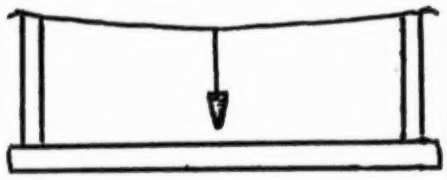
Explanation: Some materials are better conductors of sound than others.

How Does Heat Affect Metal Wire?

Materials: Alcohol burner with alcohol (or candle), 2 supports, weight, piece of copper wire.

Directions:

1. Stretch the wire between the supports.
2. Hang the weight from the middle
3. Measure the vertical distance from the weight to the table top.
4. Heat the horizontal copper wire.
5. Measure the height of the weight from the table. (The weight will be closer to the table top.)
6. Allow the wire to cool. (The weight will move up again.)



Explanation: The wire expanded when heated and contracted when cooled. Try wires made of different metals. Record measurements and summarize.

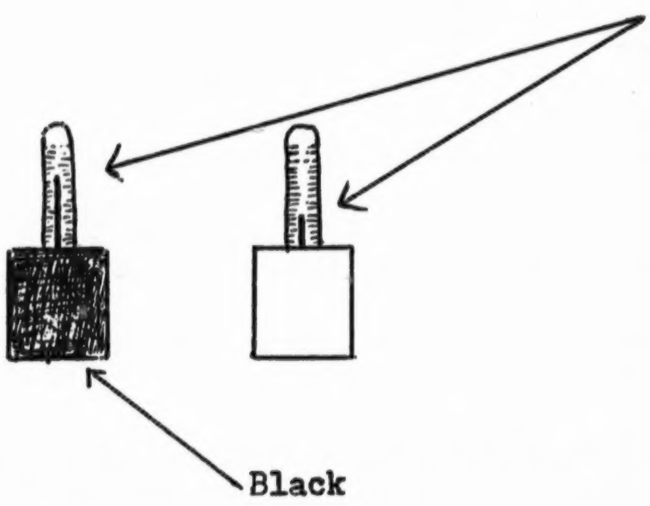
What Colors of Materials Absorb Heat Faster?

Materials: 2 tin cans; thermometer, candle.

Directions:

1. Hold one tin can in the flame of a candle until it is covered with a thick coat of soot.
2. Fill both cans with water.
3. Take the temperature of the water in each can.
4. Place both cans of water in the direct sunlight.
5. Take the temperature of the water in each can every ten minutes for about thirty minutes. (The temperature of the water in the black can rises faster than that in the other can.)

Explanation: Dark-colored objects absorb heat faster than light-colored objects.



Note height of mercury column on thermometers.

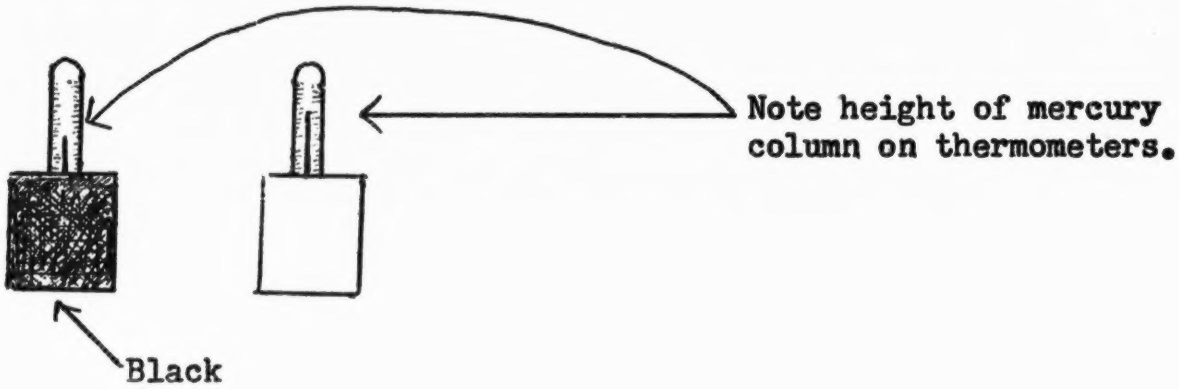
What Colors of Materials Lose Heat Faster?

Materials: 2 tin cans, thermometer, hot water, candle.

Directions:

1. Hold one tin can in the flame of a candle until it is covered with a thick coat of soot.
2. Fill both cans with hot water.
3. Take the temperature of the water in each can.
4. Place both cans in a cool place.
5. Take the temperature of the water in each can every ten minutes for thirty minutes. (The temperature of the water in the black can goes down faster than that in the other can.)

Explanation: Dark-colored objects lose heat faster than light-colored objects.

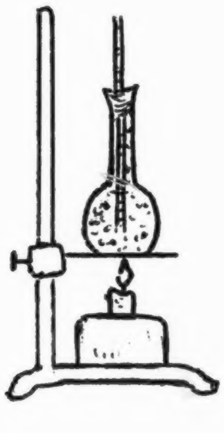


How Does Heat Affect Liquids?

Materials: Alcohol burner, denatured alcohol, flask, glass tube, 1-hole rubber stopper, support and ring, wire gauze.

Directions:

1. Fill the flask with water.
2. Insert the glass tube in the 1-hole rubber stopper. (Caution: Always wet the tube and stopper before forcing the tube through it.)
3. Fit the stopper tightly into the flask. (A little water will rise in the tube.)
4. Place the wire gauze on the ring and set the flask on the gauze.
5. Place the burner under the flask and allow it to heat for several minutes. (The water rises in the tube.)
6. Remove the burner and allow the water to cool. (The water goes down in the tube.)



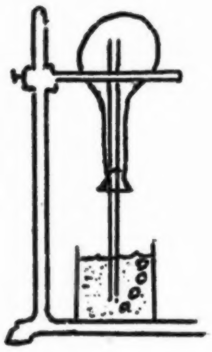
Explanation: Liquids expand when heated and contract when cooled. The rate of expansion and contraction is greater for water than for the flask.

How Does Heat Affect Gases?

Materials: Alcohol burner, alcohol, flask, glass tube, glass tumbler, one-hole rubber stopper, support and ring.

Directions:

1. Insert the glass tube in the one-hole stopper.
2. Fit the stopper into the flask.
3. Fill the glass tumbler with water.
4. Invert the flask and pass the glass tube through the ring and into the glass of water.
5. Heat the flask with the alcohol burner. (Bubbles appear at the end of the tube.)
6. Continue heating the flask a few minutes and then allow it to cool. (Water rises in the tube and into the flask.)



Explanation: Heat expanded the air in the flask and forced it into the glass of water. Cooling caused the air in the flask to contract. Air pressure on the surface of the water forced the water up the tube, taking the place of the air that was forced out.

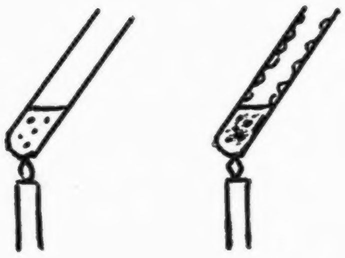
How Does Heat Affect Sugar?

Materials: Test tube, alcohol burner or candle, sugar.

Directions:

1. Place a small amount of sugar in a test tube.
2. Heat the test tube. (The sugar turns black. Moisture collects on the inside of the tube.)

Explanation: The black substance left in the tube is carbon. The moisture on the inside of the tube is water. The sugar has been broken down into the other substances. This is called a chemical change.

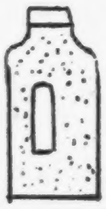


How Does the Cartesian Diver Work? (home)

Materials: Large wide-mouth bottle, rubber stopper to fit, small test tube.

Directions:

1. Fill the wide-mouth bottle level full of water.
2. Fill the small test tube about half-full of water.
3. Place your finger over the open end of the test tube and invert it into the bottle of water. (The test tube should float. If it doesn't, remove it from the bottle and pour out a few drops.)
4. Place the stopper in the bottle and press down hard on it. (The test tube sinks.)
5. Release the pressure on the stopper. (The test tube rises.)



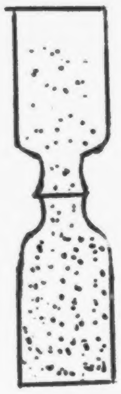
Explanation: Pressure on the stopper forces water into the test tube. The tube becomes heavier and sinks. The entrance of water compresses the air in the tube. Releasing the pressure on the stopper allows the compressed air in the tube to force the water out. The tube becomes lighter and rises.

How Does Heat Travel Through Liquids? (home)

Materials: Two milk bottles, ink, hot and cold water, cardboard.

Directions:

1. Fill one bottle with hot water.
2. Color the hot water with a few drops of ink.
3. Fill the other bottle with cold water.
4. Press the cardboard tightly against the mouth of the cold water bottle.
5. Turn the cold water bottle upside down and place it on top of the hot water bottle. Be sure that the top bottle fits exactly over the bottom one.
6. Slide the cardboard carefully from between the two bottles. (The hot water moves up from the lower bottle into the upper bottle.)



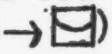
Explanation: Cold water is heavier than hot water. Since it is heavier, it begins to sink down into the lower bottle and push the lighter, warm water upward.

METRIC SYSTEM EXERCISE

NAME________________________________PER.______DATE_______GROUP____

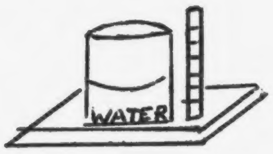
EXPERIMENT - MEASURING

Directions and Data:

1. Pour 80 ml. of red water into the plastic beaker. (Read the meniscus at the bottom→ )

2. From the plastic beaker, pour 10 ml. of the solution into the graduated cylinder. Be accurate; use the eye dropper if necessary. Now pour the measured 10 ml. into the glass beaker. Repeat until 60 ml. have been added, then measure the height of the liquid from the table to the meniscus as indicated and record.

   Height in cm. ___________



3. Fill the plastic beaker to 100 ml. from the reserve and add the following amounts as before. Be accurate.

   7 ml.   4 ml.   3 ml.   5.5 ml.   4.5 ml.   6 ml.

   Upon completion of the above, measure the height as in number 2 and record. Height ___________

4. Pour the unknown into the graduated cylinder. Don't spill. Take your reading; let someone else read it to confirm. Record. __________

5. Take a reading of the height and record. ___________
   Do not tell your reading to another group.

6. Using the rule, measure the length and width of this paper and record in the English and Metric systems.

	Metric	English
Length	______________	______________
Width	______________	______________

7. Calculate the volume of the container for your group. Record the dimentions in the metric system.

   Volume = _____________

PERIODIC TABLE

1																	2
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37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54
55	56	57-71 La Series	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86
87	88	89-103 Ac Series	104	105	106	107	108										

LANTHANIDE SERIES	57 **La** Lanthanum 138.91	58 **Ce** Cerium 140.12	59 **Pr** Praseodymium 140.907	60 **Nd** Neodymium 144.24	61 **Pm** Promethium (147)	62 **Sm** Samarium 150.35	63 **Eu** Europium 151.96	64 **Gd** Gadolinium 157.25	65 **Tb** Terbium 158.924	66 **Dy** Dysprosium 162.50	67 **Ho** Holmium 164.930	68 **Er** Erbium 167.26	69 **Tm** Thulium 168.934	70 **Yb** Ytterbium 173.04	71 **Lu** Lutetium 174.97
ACTINIDE SERIES	89 **Ac** Actinium (227)	90 **Th** Thorium 232.038	91 **Pa** Protactinium (231)	92 **U** Uranium 238.03	93 **Np** Neptunium (237)	94 **Pu** Plutonium (242)	95 **Am** Americium (243)	96 **Cm** Curium (247)	97 **Bk** Berkelium (249)	98 **Cf** Californium (251)	99 **Es** Einsteinium (254)	100 **Fm** Fermium (253)	101 **Md** Mendelevium (256)	102 **No** Nobelium (253)	103 **Lw** Lawrencium (257)

PHYSICAL AND CHEMICAL CHANGES

Teacher Information

This exercise should be done near the end of Chapter 2. Pages 45 and 46 of Chapter 3 should be assigned as preparatory reading. The laboratory exercise is intended to increase the student's understanding of the differences between physical and chemical changes. He should be lead to realize that changes similar to these, some imperceptible, others quite spectacular, are responsible for all of the changes in things that happen.

Materials	Sources
Woods metal, one tiny pellet per team	Chemistry
Small test tube, 2 per team	
Large test tube, 1 per team	
Graduated cylinder, 1 per team	Chemistry or biology
Sugar, sucrose, small amount	Chemistry or biology
Spatula, 1 per team	
Platinum or nichrome wire, (wire supporting the filament in a light bulb will work very well)	Chemistry or biology
Copper wire, 12 or 14 gauge, 3-4 inch lengths, 1 per team	Chemistry
Forceps	
Test tube holder	
Bunsen burners	
Magnesium ribbon, 1-2 cm. lengths, 1 per team	Chemistry
Ammonium dichromate, small amount	

Comments on Exercise

No. 1: Unless the student is watching carefully, he may not observe that the Woods metal has liquified in boiling water.

No. 2: Because of the danger of spilling, you may wish to demonstrate for the class the chemical action of concentrated nitric acid on Woods metal.

No. 3: The spatula refers to the small spatulas (Nonstock SPA-5220) used in semimicro chemistry. If these are unavailable, a "spatulaful" would correspond to a volume approximately equal to that of an aspirin tablet. Tasting should involve the smallest amount required to identify the material.

No. 4: It is not intended that reagents and products of the chemical reactions involved be explored in detail. The students may be lead to realize that heating copper in presence of air produces copper oxide, and burning magnesium produces magnesium oxide. Burning the ammonium dichromate should be recognized only as a chemical change because of the altered appearance. (The primary reaction is $(NH_4)_2 Cr_2O_7 \longrightarrow N_2 + 4H_2O + Cr_2O_3$.)

PHYSICAL AND CHEMICAL CHANGES

Exercise NAME ____________

Matter all around us is constantly undergoing changes. In Chapter 2 you learned about the three states of matter--solids, liquids and gases and how solids may be changed to liquids and liquids to gases. How would you change lead (solid) to a liquid? __________ How would you change liquid water to a solid (ice)? __________ If you then let the liquid lead and the ice stand for a while at room temperature, they will change back to their original state. These are examples of physical changes.

In the exercises which follow you will observe other examples of physical changes and a different kind of change called chemical change.

1. Put 1 ml of water in a small test tube and heat the water to boiling. Put a piece of Woods metal about the size of a BB shot into the boiling water. Carefully observe and describe what happens to the metal.

   ____

   Cool the test tube by allowing cold water to run around the outside of the tube. Remove the metal. Examine and describe it.

   Did the metal undergo a physical change? ____________

   Explain your answer. ______________________________

   ____

2. Next place the piece of Woods metal in a small test tube and add ten drops of concentrated nitric acid. The gas that is given off is slightly poisonous so do not allow the reaction to continue too long.

   Explain how this action differs from the above action of Woods metal and hot water. ______________________________

   Has the metal undergone a seemingly permanent change, producing a new chemical? __________ If so, a chemical change occurred.

3. Place a clean spatulaful of sugar in a clean small test tube containing about 1 ml of water. Taste the resulting solution cautiously.

   Does the change in appearance of the sugar change its taste? ________

   Do you think a new chemical was produced? __________ Which of the two kinds of changes occurred? ______________________________

   Heat a drop of the above solution on a clean glass slide; cautiously pass the slide back and forth over the flame until dry. Describe the taste and appearance of the residue. ____________________

____

Which type of change occurred? ____________________

4. Examine a piece of platinum wire. Observe its flexibility and luster. Heat the wire to redness in the flame of the burner and note its appearance. Let the wire cool and again examine its properties.

   When platinum wire is heated, is the change physical or chemical? ____

5. Repeat the experiment in "4" using a piece of bright copper wire. Compare the properties of the copper wire before and after heating.

   How does the surface of the copper change in appearance? __________

   Does the copper return to its original appearance? ______________

   Which type of change occurred? ____________________

6. In chemical changes, one or more new substances (chemical) are formed. Also, when chemical changes occur, heat is usually either absorbed (endothermic) or given off (exothermic).

   Name a device that produces electricity as a result of a chemical change. ____

   Name a chemical change that gives off heat. ________________

   With a forceps, hold a piece of magnesium ribbon about 1 cm long in the burner.

      How does the new substance differ from the original metal? What has the magnesium combined with? ________________

      Name this compound that is formed from burning magnesium. ______

      Write a word equation for the reaction. ________________

      ____

      Write what evidence you have noticed of a chemical change and point out whether energy is involved in the reaction. ________

      ____

   Heat 1 spatulaful of ammonium dichromate in a large, dry test tube. When the reaction begins, withdraw the tube from the flame and allow the product to fall on a piece of paper.

      Record your observations. ____________________

      ____

Which type of change occurred? ____________________

Is there evidence of energy? ________ Is it absorbed or given off? ____________________

Write down how a chemical change may be distinguished from a physical change.

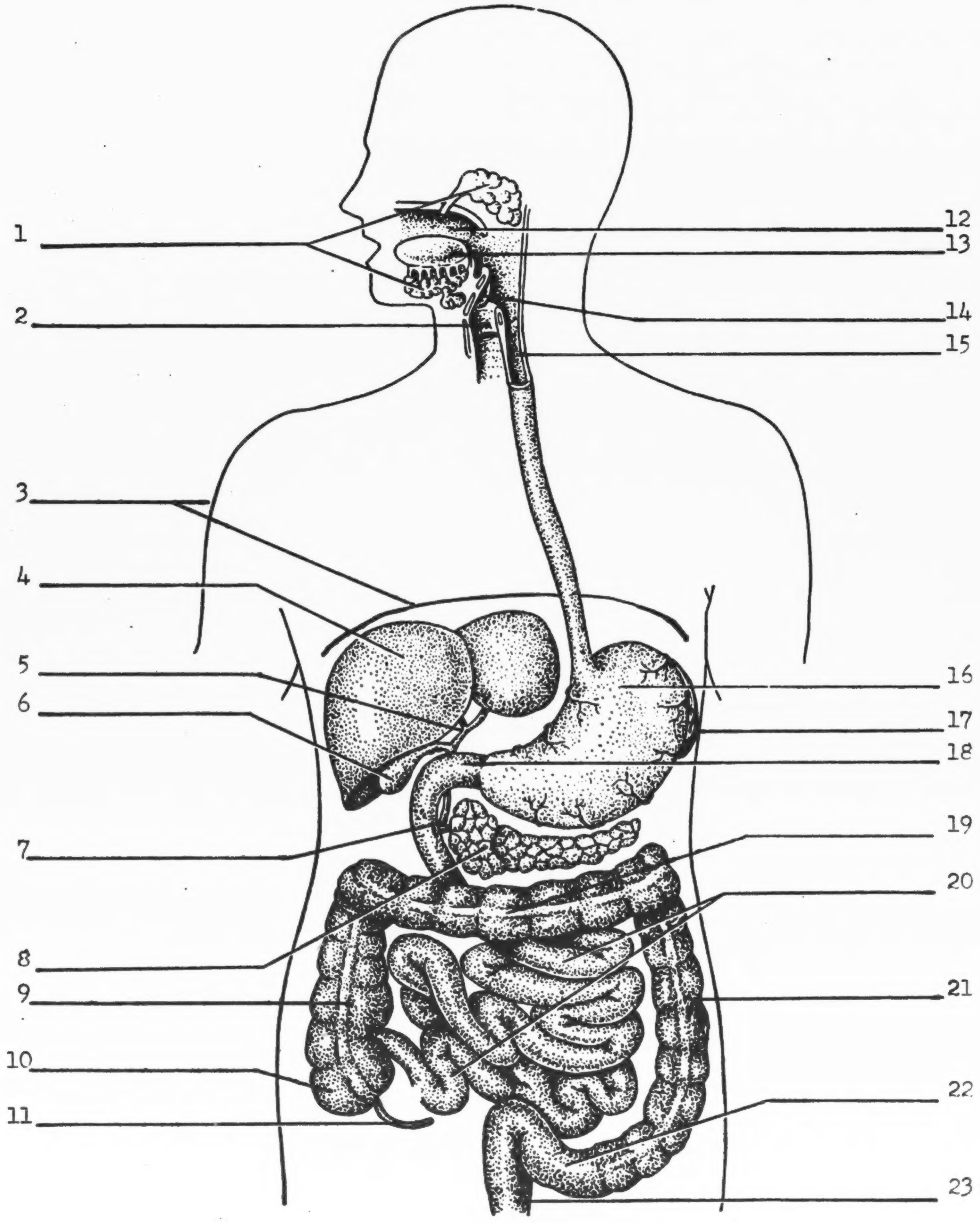
____

____

NAME______________________

Digestive System

Label the parts of the body that are indicated. Designate the different organs by coloring them in.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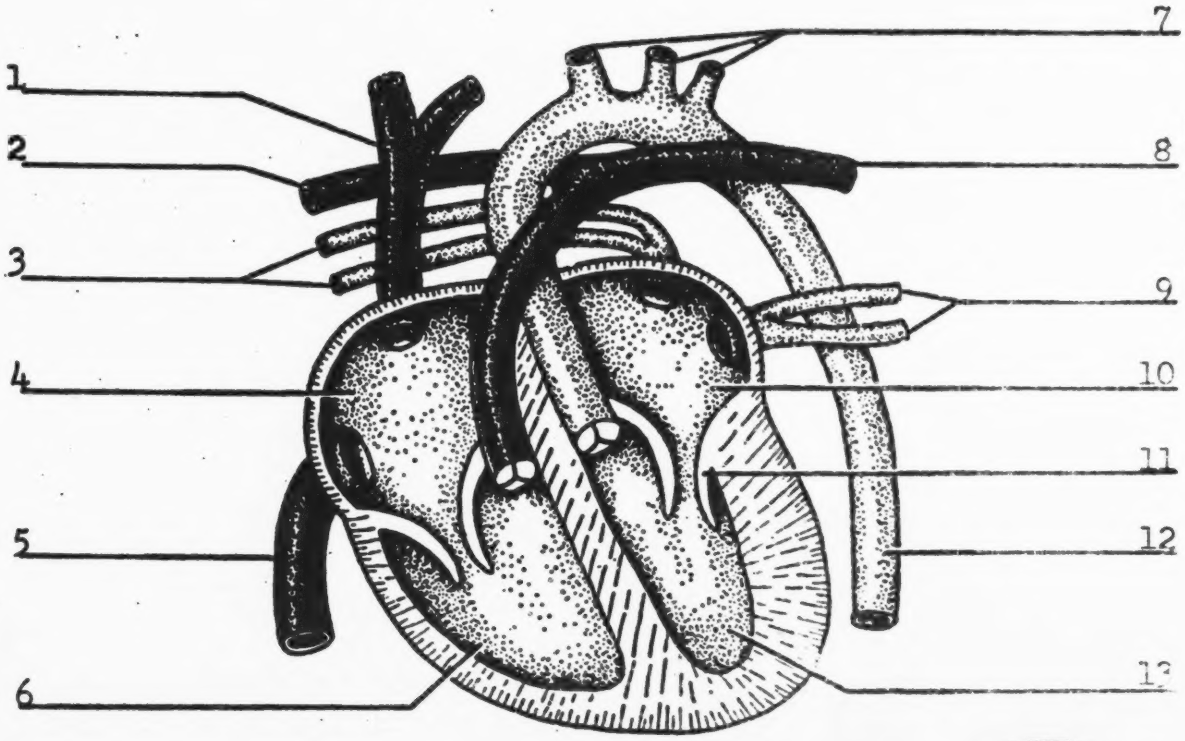
NAME____________________

Circulation

HEART

Label the human heart, showing veins, arteries, auricles, and ventricles, and add arrows to show the direction of the flow of blood.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2
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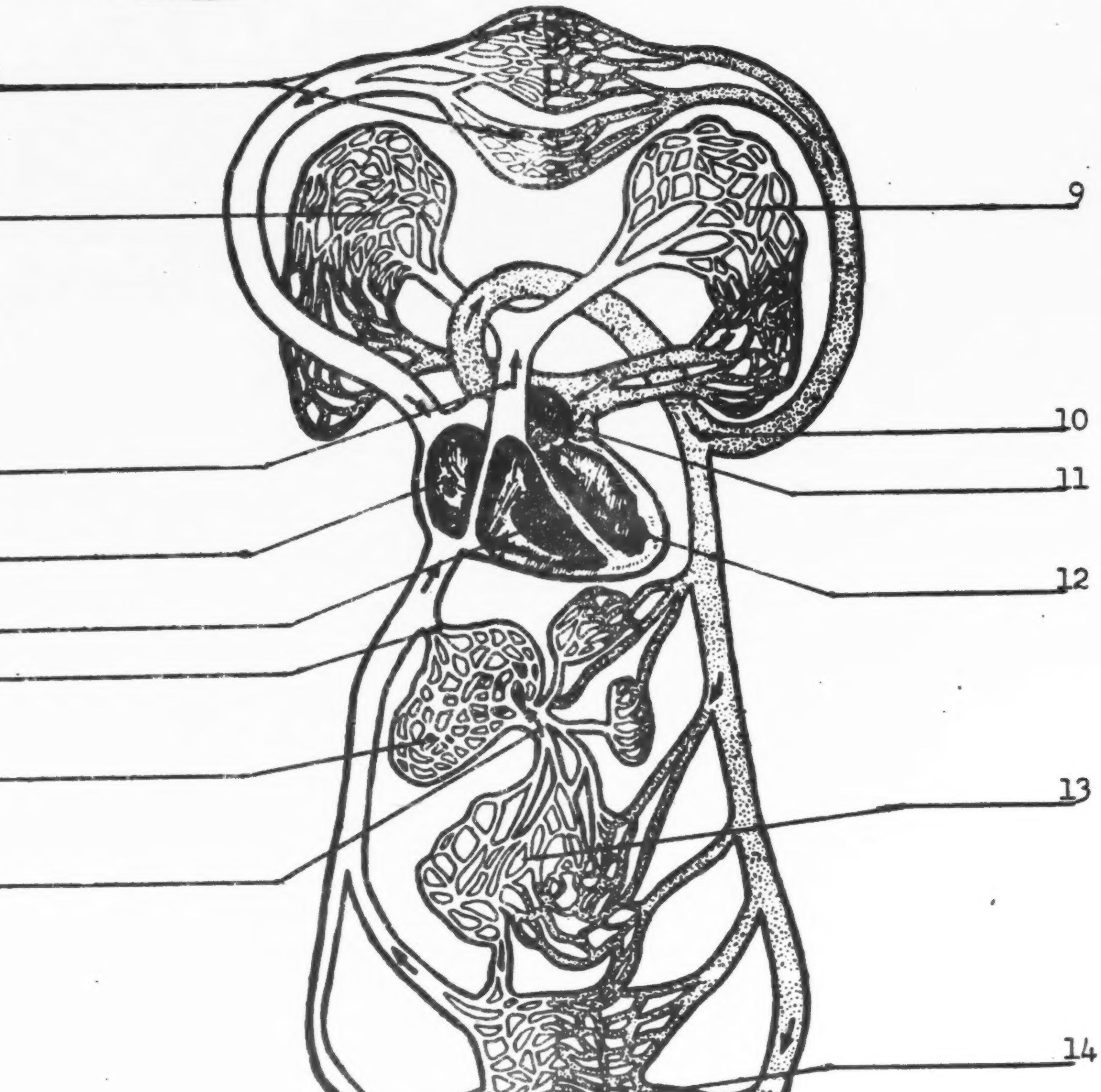
12
13

CIRCULATORY SYSTEM

In this diagram label the parts and color all arteries red and all veins blue.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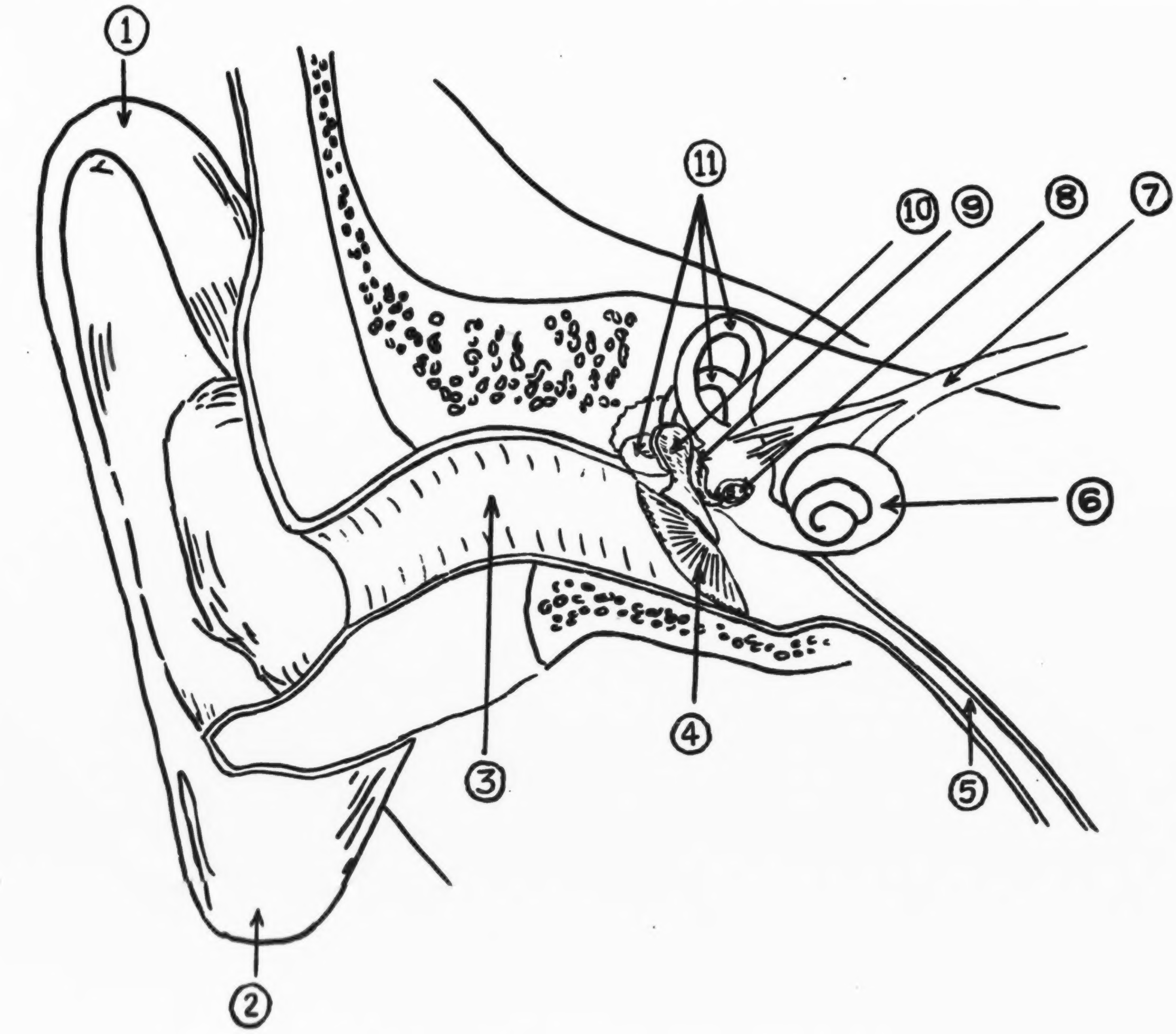
HUMAN EAR

Ear

NAME ______________________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⑦
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⑪

NAME - FUNCTION

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5 ______________________

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8 ______________________

9 ______________________

10 ______________________

11 ______________________

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SOUND WAVES

NAME______________________________DATE_______________PER._____

DEFINITIONS:

Frequency of a vibratory motion (wave motion) is the number of vibrations per second. Is equal to the velocity of the sound wave divided by the wavelength.

Pitch depends upon the frequency; the higher the frequency the higher the sound.

Sine wave is used to illustrate the motion of sound. It has a midpoint, low point, and a high point.

Velocity of sound or the speed at which sound will travel is dependent upon the temperature and the material in which it is traveling. In air at 0 C. it is 1,120 feet or 332 meters per second, approximately 760 miles per hour.

Vibration is the number of times an object moves back and forth to produce a sound. It is always stated in terms of vibrations per second.

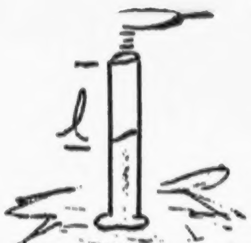
PROBLEM: Does a sound wave have a definite length and can this length be determined by experimentation?

PROCEDURE: Using a closed tube and water to change the effective length of the tube, find the point at which the note of the tuning fork is reinforced to its maximum. Use several different notes and calculate by using the following formula.

$$L = 4(l + 4d)$$

L - length of the sound wave
l (small l) - effective length of tube
d - diameter of the tube being used

MATERIALS:
Graduate or cylinder
Water and flask
Rubber mallet
Meter stick
Tuning forks



OBSERVATIONS: Velocity of sound used in experiment _______________

Tuning fork (vib./sec.)	l - length from top to water level	d - diameter of the tube used	L - experimental length found

Check each experimental result with this formula. $\frac{\text{Distance sound traveled in sec.}}{\text{Vibrations per second}}$

CONCLUSION: Answer the question asked in the problem statement.

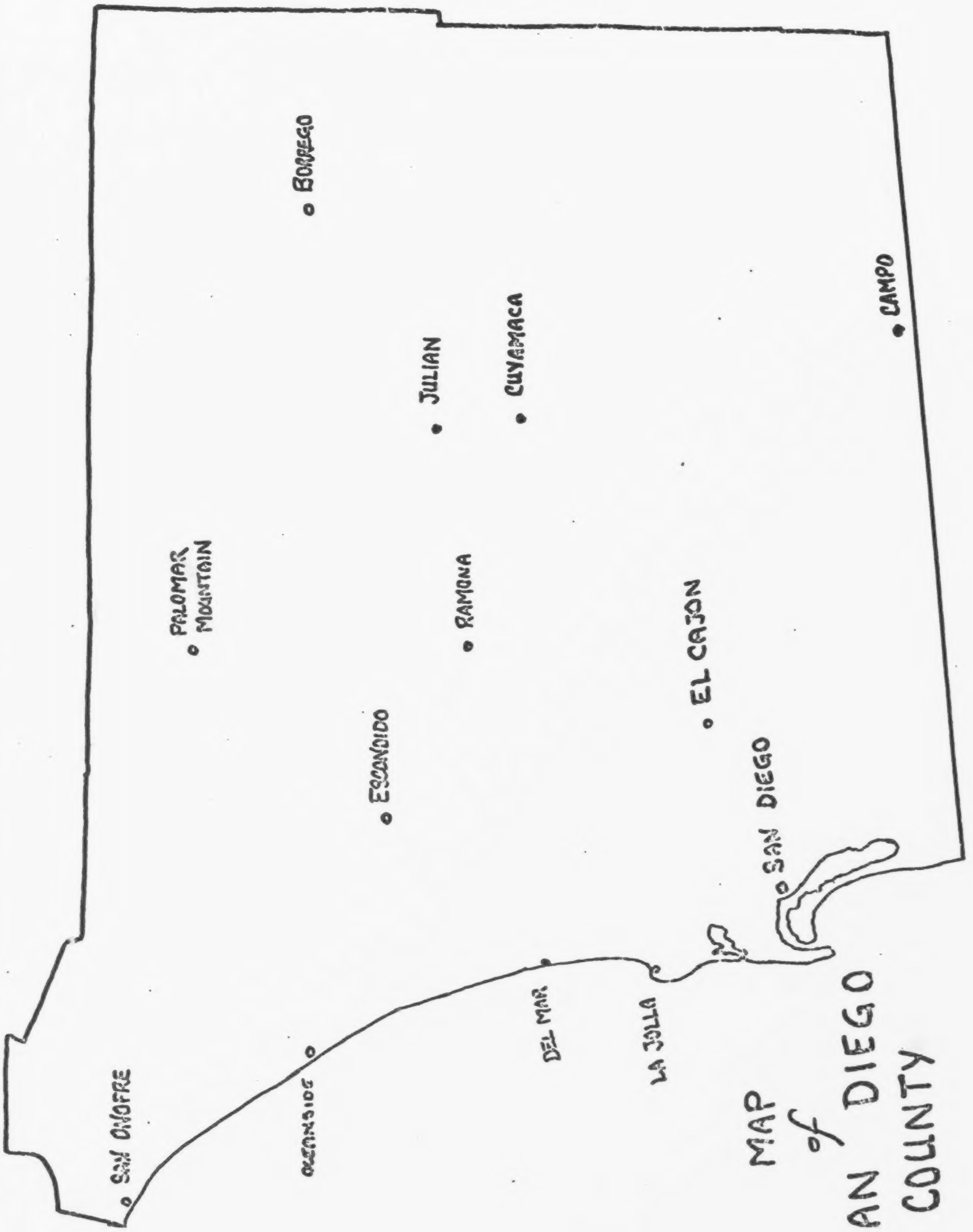
____
____
____
____

SOME USEFUL COMPOUNDS

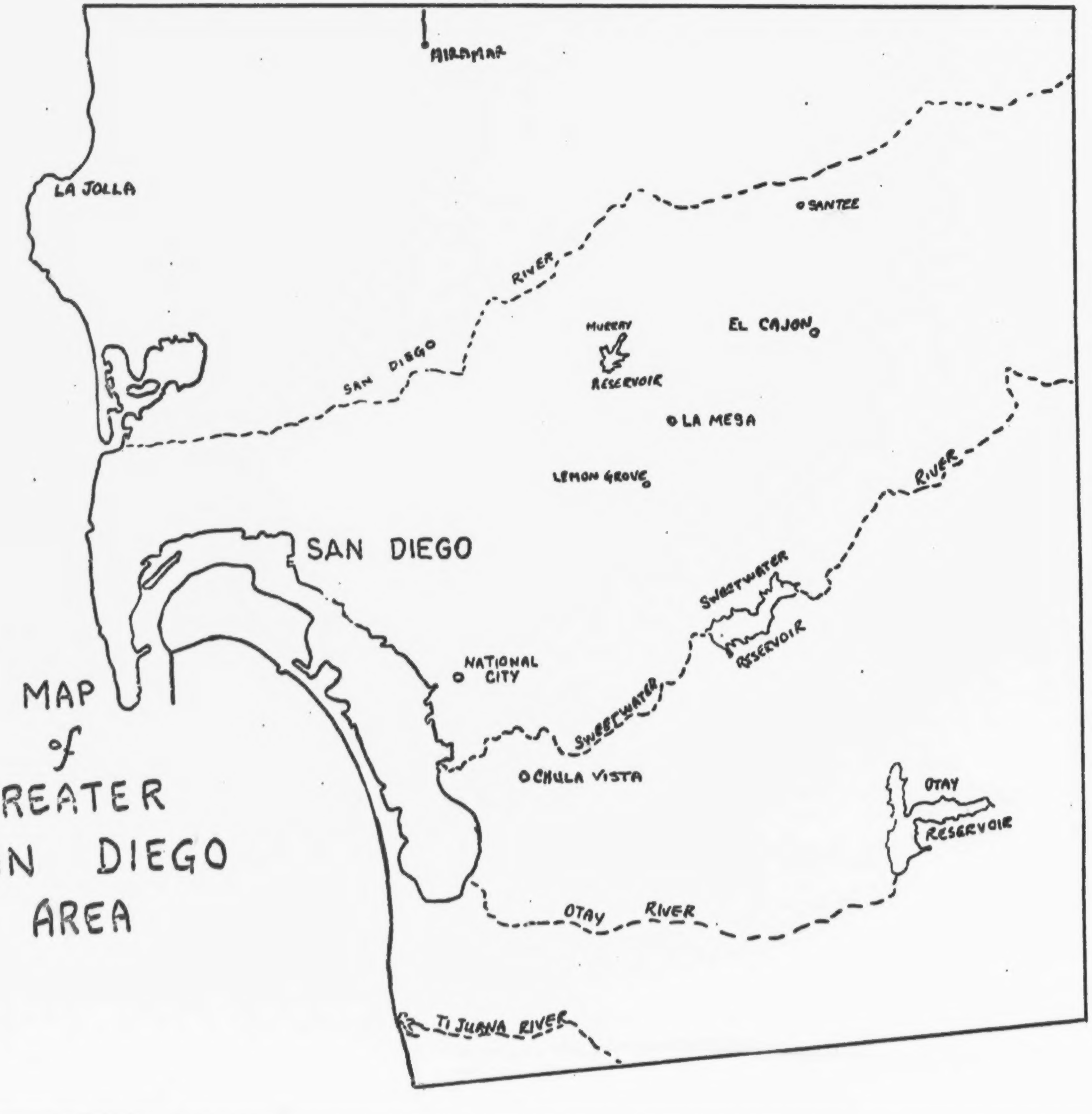
Common Name	Chemical Name	Formula	Uses
Alcohol, grain	Etyhl alcohol	C_2H_5OH	Solvent, antifreeze
Baking soda	Sodiom bicarbonate	$NaHCO_3$	Fire extinguishers, baking, medicines
Carbon tetrachloride	Tetrachloromethane	CCl_4	Cleaning fluid, fire extinguishers
Dry ice	Carbon dioxide (solid)	CO_2	Refrigeration
Ethyl	Lead tetraethyl and Ethylene bromide	$Pb(C_2H_5)_4$ $C_2H_4Br_2$	Antiknock in gasolines
Limewater	Calcium hydroxide (solution)	$Ca(OH)_2$	Water softening, bleaching
Lye or caustic soda	Sodium hydroxide	$NaOH$	Household cleaning, soap
Peroxide	Hydrogen peroxide	H_2O_2	Bleaching, antiseptic
Prestone	Ethylene glycol	$C_2H_4(OH)_2$	Antifreeze
Sand, silica	Silicon dioxide	SiO_2	Glass, buildings
Sugar, corn syrup	Glucose, dextrose	$C_6H_{12}O_6$	Sweetening, preserving fruits
Sugar, cane or beet	Sucrose	$C_{12}H_{22}O_{11}$	Sweetening, preserving foods
Table salt	Sodium chloride	$NaCl$	Seasoning, preserving foods, mfg. of chemicals
Vinegar	Acetic acid	CH_3COOH	Seasoning

SOME USEFUL ELEMENTS

Name	Symbol	Description	Uses (alone or in compound)
Aluminum	Al	Bright, silver-colored metal	Kitchen utensils, automobile and airplane parts
Argon	Ar	Colorless, odorless gas	Electric light bulbs
Boron	B	Brittle, reddish-white metal	Boric acid, borax, rocket fuel
Bromine	Br	Brownish-red liquid	Gasoline additive, photographic film
Calcium	Ca	Silver-white metal	Limestone, limewater, bleaching powder
Carbon	C	Black solid or clear crystals	Coal, diamonds, pencils, ink
Chlorine	Cl	Greenish-yellow gas	Table salt, germicide
Chromium	Cr	Silver-white metal	Automobile plating, stainless steel
Copper	Cu	Reddish-brown metal	Coins, electric wires, kitchen utensils
Hydrogen	H	Light, colorless gas	Fuel, welding, shortening
Iodine	I	Gray solid or purplish-black crystals	Germicide, medicines
Iron	Fe	Silver-white metal	Buildings, steel, magnets
Mercury	Hg	Silver-colored liquid metal	Thermometers, electric switches, fillings for teeth
Oxygen	O	Colorless gas	Burning, breathing
Silicon	Si	Brown powder or gray crystals	Glass, main element in many rocks and minerals, jet and rocket lubricants


BORREGO
CAMPO
JULIAN
CUYAMACA
PALOMAR MOUNTAIN
RAMONA
EL CAJON
ESCONDIDO
SAN DIEGO
DEL MAR
LA JOLLA
OCEANSIDE
SAN ONOFRE

MAP of SAN DIEGO COUNTY

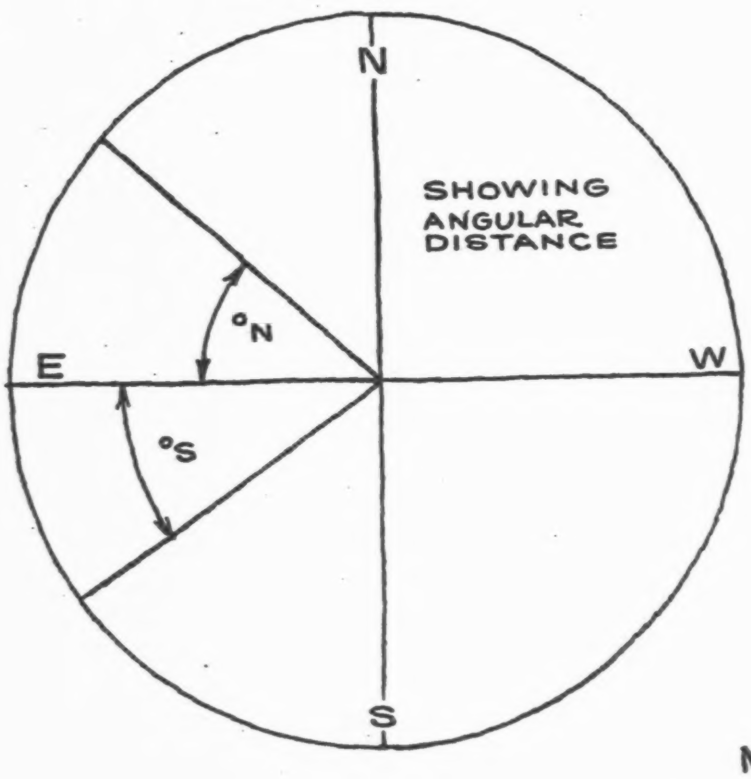

MIRAMAR
LA JOLLA
SAN DIEGO RIVER
SANTEE
MURRAY RESERVOIR
EL CAJON
LA MESA
LEMON GROVE
SAN DIEGO
NATIONAL CITY
SWEETWATER RESERVOIR
RIVER
SWEETWATER
CHULA VISTA
OTAY RESERVOIR
OTAY RIVER
TI JUANA RIVER

MAP
of
GREATER
SAN DIEGO
AREA

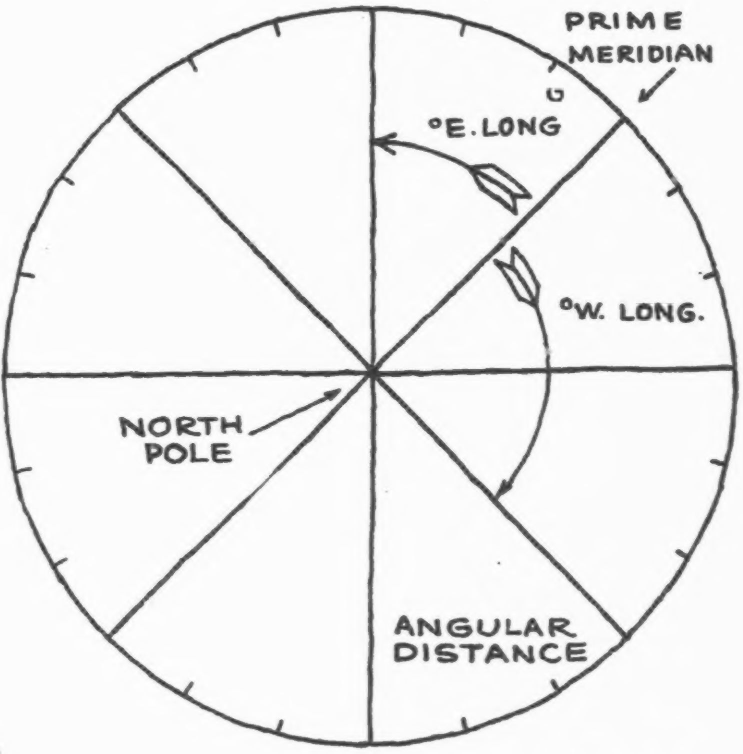
MEASUREMENT OF LATITUDES AND LONGITUDES

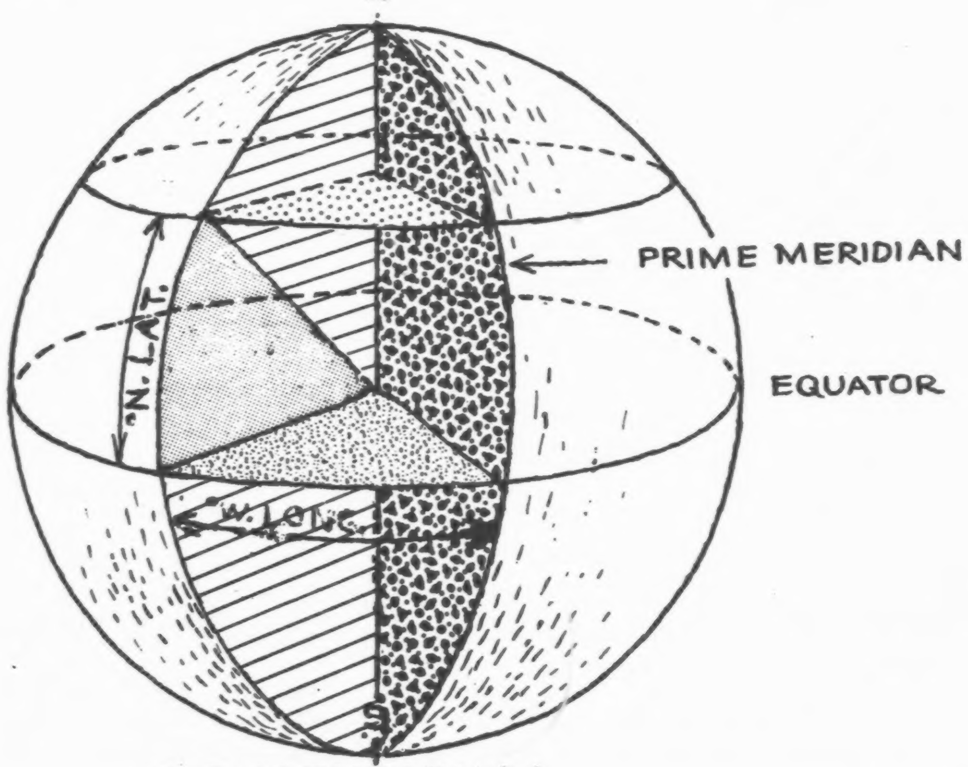
Diagrams

LATITUDE


N
SHOWING ANGULAR DISTANCE
°N
E
W
°S
S

LONGITUDE

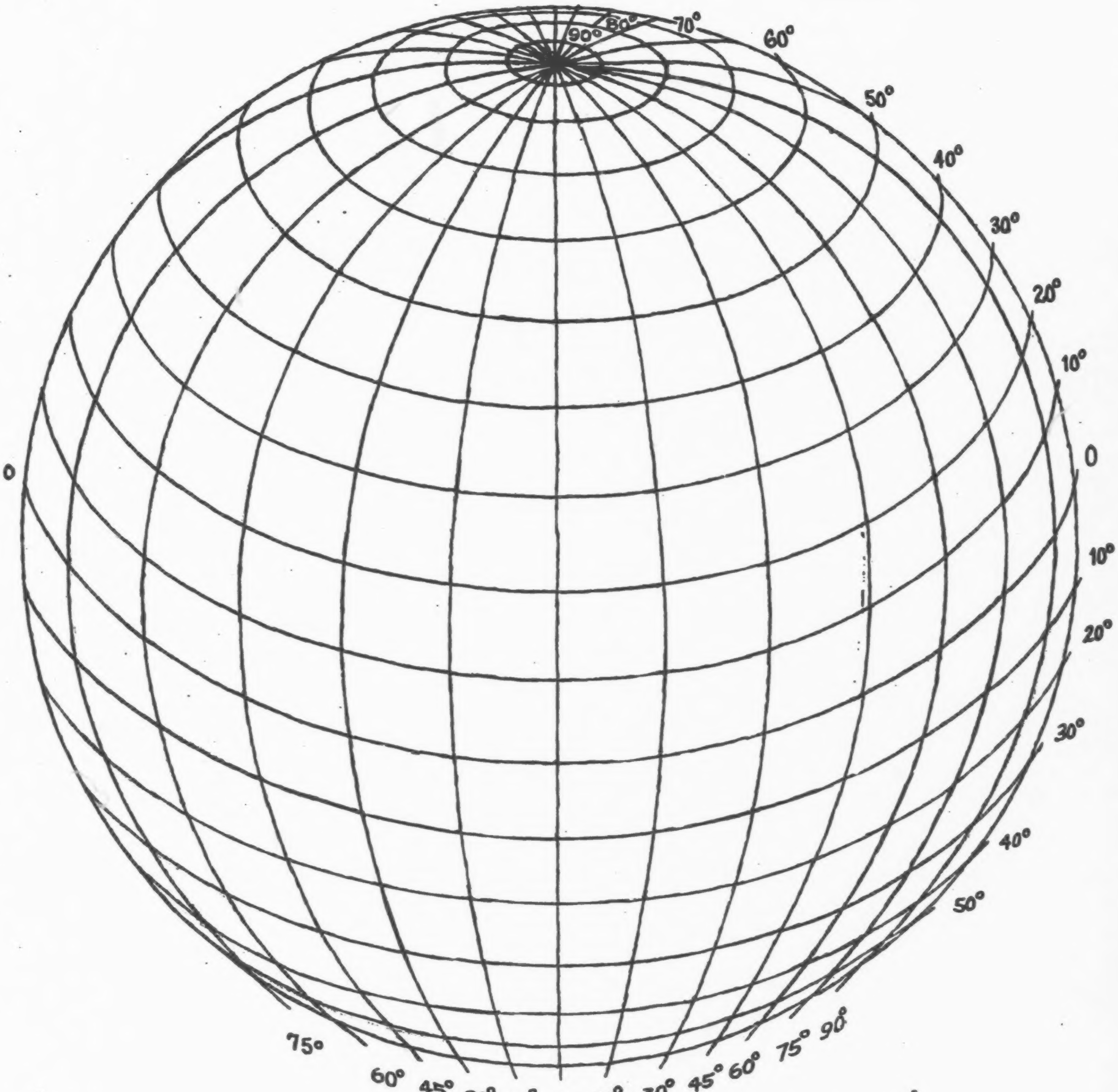

PRIME MERIDIAN
G
°E. LONG
°W. LONG.
NORTH POLE
ANGULAR DISTANCE


N
PRIME MERIDIAN
EQUATOR
°N. LAT.
°W. LONG.
S

3-DIMENSIONAL

MEASUREMENT OF LATITUDE AND LONGITUDE

Work Sheet


90°
80°
70°
60°
50°
40°
30°
20°
10°
0
10°
20°
30°
40°
50°
0
75°
60°
45°
30°
15°
0
15°
30°
45°
60°
75°
90°

Locate the following points whose latitude and longitude are given below.

A. ______________
B. ______________
C. ______________
D. ______________
E. ______________
F. ______________
G. ______________
H. ______________
I. ______________
J. ______________
K. ______________
L. ______________
M. ______________
N. ______________
O. ______________

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☐ 9. Flying weather information, what it means to the pilot. 5¢.

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☐ Cloud code chart. (36 pictures of cloud formations.) 10¢. Catalog No. C 30.22:C 62/2/958

☐ Tornado safety rules, to know what to do when a tornado is approaching, may mean the difference between life or death! [all lettered poster]. 10.5 x 8 in. 5¢. Catalog No. C 30.6:T 63/2/960

☐ Tornadoes, what they are and what to do about them. (Tells about tornadoes, tornado warnings, tornado precautions.) 5¢. Catalog No. C 30.2:T 63/4/962

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